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TRANSPORTATION IN PARIS.

All the recent accounts from Paris go to show that the transportation system in that city has been under a severe strain recently, and may be said to have broken down. As will be seen, our special correspondent there reports in a note this week the serious riots that occurred at Whitsuntide, when the people, exasperated by long waiting, stormed the omnibus and car offices and mobbed the cars. Another correspondent in Paris reports that the trip to Vincennes and back on Whit Monday—a distance each way of six miles—occupied over five hours. There can be no doubt that the new electric car lines and underground road cannot be put in operation any too soon, especially as the cabmen have of late become more than usually insolent and extortionate. This situation is in curious contrast to that within the grounds of the Exposition, where the moving sidewalk and the third-rail road have made rapid transit a reality. It is said that if you want to travel quickly in Paris now you must go to the Exposition. The description which our correspondent gives of the sidewalk this week brings out a number of points of interest in regard to that highly successful novelty. The walk is now carrying as many as 150,000 people a day, and it is a matter of pride to all Americans who visit the show to remember that the apparatus working so smoothly and efficiently under exacting conditions owes its origin to American manufacturers or to American skill and experience now being applied in France along the same lines. If one looks for the triumphs of American electrical engineering at the Paris Exposition, they are certainly manifested in its transportation facilities. And the curious thing is, that the new surface and underground facilities for Paris are all American as well, and are being awaited by a long-suffering public with an anxiety that is really pathetic.

POLYPHASE TRACTION.

In these columns in our issues of Feb. 10 and Mar. 31, some of the difficulties to be met in the design of the polyphase motor for traction work were considered, and an interesting discussion of the subject in our correspondence columns followed. Recently, the results of some European polyphase traction experiments have come to light having an important bearing on the subject. From a paper of Mr. Walter Reichel, an abstract of which is given in this week's Digest, it appears that the Siemens & Halske Company, of Berlin, has since 1898 been making experiments on a trial line. The system with which they experimented was that of high-tension transmission by overhead wires at 10,000 volts, the current being taken off by sliding contacts and transformed by transformers on the locomotive for supply to the polyphase motors. We are not aware that such a system has yet been applied on any actually operated line. On all polyphase lines thus far installed, there are transformer stations along the line, and on the Lecco-Colico-Gondrio line, the transmission voltage is 20,000, the three-phase motors being operated at 3000 volts.

Mr. Reichel erroneously refers to this line as an example of a system where polyphase currents between 1000 and 4000 volts, generated in the power-house, are transmitted over the line and supplied to the motors on the locomotive without any transformation; such a system is, of course, entirely practical for a line of moderate length and is very simple, but we do not know of any case where it has been

applied in practice. For long-distance trunk lines, however, the system experimented with by the Siemens & Halske Company appears to be the most feasible. The main question was whether at a voltage of about 10,000 the current can be well taken off by contacts sliding along the trolley wires with high speed. That this question has been answered in the affirmative, appears to be shown by the trials, the sliding contacts working even better at 10,000 volts than at 2,000 volts. The speed, however, did not surpass 37 miles per hour in these trials, so that it is still an open question as to how the sliding contacts will behave at a considerably higher speed. Some further German experiments which promise to be of much value will be made, as we noted some time ago, under the auspices of several of the leading banking and industrial firms of Germany, and with the active support of prominent officials of the government. Preliminary to the taking up of the work, a company has been formed in Berlin for studying theoretically and experimentally the application of electric traction to trunk railroads—its whole capital of $375,000 to be spent in these investigations. An experimental line of nine miles in length is projected. In the meantime, a prize competition has been arranged for a solution of the problem of the design of the terminal stations of a long-distance electric trunk railway on which the trains are to be run with a speed of 124 miles per hour.

Direct and Alternating Currents on the Same Line Wires.

When an alternating current is superposed upon a relatively larger direct current in the same conductor, the alternating current lowers the current density during the half periods when its flow is in opposition to that of the direct current, and increases the density by the same amount during the other half cycles when it flows in the same direction as the direct current. On this account it might at first sight appear that the addition of the alternating current would not change the average loss due to the resistance of the conductor, but that this loss would remain the same as with the direct current flowing alone. During those half periods, however, when the alternating current adds to the direct current, the square of the resultant increases to a greater extent than it diminishes when the alternating current subtracts from direct current. On this account the I^2R loss is greater than that of the direct current alone, although less than that which would be set up in the same conductor by a current with the valve equal to the sum of the direct and virtual alternating currents. In a paper presented this week before the New York meeting of the American Association for the Advancement of Science, and reprinted in abstract on another page of this issue, Dr. Frederick Bedell shows mathematically that the total I^2R loss of the resultant of these two unlike currents existing simultaneously in one conductor, no matter what their relative value may be, is equal to the sum of the two losses which would be occasioned by the two currents existing separately in the same conductor. In other words, each current undergoes a loss which is quite independent of the presence of the other, and acts as though the other did not exist. The same is true of the IR drops of voltage set up by the two currents.

Turning aside from the scientific side of this interesting proposition, which is thoroughly covered in the reprint on another page, it is interesting to note what practical application can be made of this property of composite working with alternating and direct currents. That it shows promise of considerable possible saving of copper or copper losses is evident from the fact that a conductor carrying a given number of amperes of alternating current and simultaneously an equal number of amperes of direct current, has only half as great a I^2R loss as though it carried an alternating or direct current equal in amperage to the sum of the given direct and alternating currents. While it may appear at first sight that this gain would be accompanied by an increased maximum difference of potential between different portions of the circuit, equivalent to raising either the direct or alternating voltage to such an extent as to obtain the same economy by a simple means, a perusal of recent patents on such a system issued to the writer of the paper above referred to shows that this is not necessarily the case, and that in any event the difference of potential delivered to the translating devices is not altered. These patents show that the proposed practical application of this property of combined direct and alternating currents is briefly as follows: A direct current is to be introduced into alternating-current circuits very much as telegraph signals are introduced into telephone wires in the Van Rysselberghe system of composite telegraphy and telephony. On a single-phase, alternating line, for example, with a transformer at each end, direct current is introduced through a tap in the middle of the winding of one transformer, one-half of the direct current flowing in one direction through one-half of the transformer winding and one of the two line wires, the other half of the current flowing in the other direction through the other half of the transformer and the other line wire to the transformer at the distant end of the line from which the direct current is drawn from a tap in the middle of the winding similar to that by which it was introduced. The return path of the direct current is either a third wire or another alternating line similarly equipped. Since the direct current divides and flows differentially in opposite directions through the two halves of the windings of the transformers, it has no resultant magnetomotive force tending to polarize the magnetic circuit of the transformers.

Considering the possibilities of the application of such a system of copper saving in the several classes of electrical service, it is obvious in the first place that it is applicable to high-tension, long-distance transmission, for the reason that the resistance of the circuits used in such transmissions is so great that a pressure of 5000 or 10,000 or 20,000 volts is necessary, either direct or alternating, to utilize them economically, and this pressure is not practicable with direct current. Coming down to more ordinary pressures, lines now carrying alternating currents at the usual pressure of 2200 volts might be utilized for the simultaneous transmission of both kinds of current; but here again, to obtain the highest saving of copper or copper losses the direct current should be equal to the virtual value of the alternating current and, on account of the high resistance of the circuit, the direct pressure should be of the same order of magnitude as the alternating voltage, i. e., it should be about 2000 or 3000 volts. Constant-potential, direct-current machines of this pressure are not used in this country, but it might be possible to carry series arc currents over primary alternating circuits if the added complication and the mutual disturbances due to slight faults, such as grounds or the burning of a fuse, on either system, did not overbalance the gain of copper.

Coming down to the usual pressures of direct current, viz., 550 and 220 volts, it is obvious that no alternating currents can be safely introduced into such circuits unless the alternating voltage is of the same order of magnitude as the direct voltage. For instance, if the attempt were made to put 2200 volts alternating on a 220-volt direct-current circuit, the insulation of the lines would be broken down if they were under ground, and the motors and lamps would become immediate sources of danger in any case. Such a course would not be considered for an instant by those responsible for the safety of electrical installations. On account of the fact that the maximum instantaneous value of an alternating current is greater than the virtual or rated value, and on account of the superposition of the different kinds of pressure on a network, the alternating voltage should, indeed, be considerably less than the direct to prevent

an increase of dielectric strains when some part of the intermeshed system becomes grounded. There is also the danger of introducing alternating currents into the direct-current apparatus, provided, for instance, a fuse blows in one of the alternating lines, or a similar trifling departure from normal operation occurs. It is possible, of course, to transmit considerable power by means of alternating currents over direct-current lines at a voltage equal to or less than that of the direct current, but the fact remains that alternating currents are particularly well adapted to the reduction of copper losses by transmission at a comparatively high pressure and transformation from this high pressure to that of the translating devices. This gain is immediately lost in the composite system in which it becomes necessary to transmit the alternating currents at low pressure.

It is therefore questionable whether a composite system with both currents at low pressure would effect any gain over the independent system with direct current at low and the alternating at high pressure. For instance, in the case of a transmission or distribution of a given amount of power by means of direct current at 220 volts and a substantially equal amount of power by means of alternating current, it would probably be simpler, cheaper and less troublesome to transmit or distribute the alternating current at 2200 volts on its own wires than to do it at about 220 volts on those conductors that carry the direct current. The copper loss which the alternating current would add to that of the direct current in the case of the composite system would be greater than the comparatively trifling loss of the alternating current in its own wires at ten times as high a pressure. There are, of course, gradually growing in the more crowded lighting districts of the larger cities secondary low-potential alternating-current networks fed by transformers at frequent intervals, and these networks might be used for the simultaneous distribution of both kinds of current. Here, however, again the demands of the two classes of service do not call for the same layout of copper, the direct current coming entirely from the central station and calling for tree-like feeders and mains starting from that point, while the alternating current comes from transformers feeding into the network at a comparatively large number of points. It is therefore difficult to see how the two currents can be profitably combined in the same copper, although this interesting property of reduced losses opens up a broad field of possible development in connection with other advances in the art.

ELECTRIC LEAKAGE AT HIGH PRESSURES.

It is wonderful how little electricity escapes from insulated conductors in commercial distribution. The loss in telegraphy is often considerable, owing to the relatively great lengths of line, and the fact that such lines may pass through many trees and over thousands of dusty insulators; so that in bad weather the arriving current may be only a small fraction of the outgoing current. Nevertheless, the total energy lost expressed in watts is always very small, as is evident when we see the small dynamo plant which suffices to supply the wants of a large telegraph station. As the pressure increases, say to 230 volts, as in the three-wire system of incandescent lighting, the current output may be 100,000 amperes, and yet the loss may be only a few paltry amperes. At 500 volts pressure the loss on railroad circuits is sometimes appreciable when expressed in amperes, but expressed in kilowatts or in dollars and cents it is usually insignificant, while at 1000 or 20,000 volts the same remark applies.

It would seem that an electric discharge must either make a short-circuit or stop, and that no intermediate condition can exist except as trivial leakage. This is a most fortunate generalization, and upon it long-distance transmission may be said to depend. If porcelain and glass insulators instead of cracking and breaking down destructively, permitted a large leakage to occur without breaking down, the problem of electric transmission would be a much more serious and difficult one that it actually is. In other words, it is the property of a metal to conduct electricity, and it is the property of non-metallic bodies to allow electricity to leak through them by driblets that are commercially trivial or else to discharge through them with violence and short-circuit.

ELECTRIC HEATING AND COOKING.

It is interesting to observe the gradual but steady advance of electric heating for culinary purposes in large cities. We take it for granted that electric heating on a large scale cannot be efficient or economical, except in very special instances. Thus it is out of the question to consider an electric heating plant for raising large vats of liquid to the boiling point unless there are some very special reasons why chemically evolved heat may not be used. A kilowatt-hour in heat is about 3600 B. T. U. and costs a consumer in our large cities from 5 to 20 cents, according to the conditions, or from 72,000 to 18,000 thermal units per dollar. On the other hand, a short ton of ordinary good steam coal will contain 28,000,000 of B. T. U., and allowing a loss of 25 per cent in a boiler wall and flue, some 21,000,000 of heat units can be looked for in the boiler water, such coal costing about $1 to $3, according to circumstances, and representing a yield of from 21,000,000 to 7,000,000 of thermal units per dollar, or in the neighborhood of three hundred times more heat than the electric method would furnish. The comparison is in a certain sense unjust, seeing that the retail price of electric energy on a small scale is compared with the manufacturing cost in fuel alone for heating water on a large scale, and a far better relative showing could be made where both methods were compared from either the manufacturer's or the purchaser's standpoint, whatever the scale of production might be; for example, where a large turbine drives a generator below full load, the cost of supplying electric heaters in the power house may be practically nil, no extra labor being required beyond the act of connecting or disconnecting them, while the water power runs unpriced. The only reliable statement that can be reached applicable to all conditions is that where heat is obtained from combustion, it must be much cheaper to produce the heat directly where required, than to supply the heat to an engine and dynamo and reproduce the heat electrically, seeing that the efficiency of the boiler, engine, dynamo and transmission wires can hardly be more than 15 per cent and is commonly less than 5 per cent.

It is only on a large scale, however, that price sways the sceptre. On a small scale price often becomes insignificant by comparison with comfort and convenience. It is declared by some builders from their actual observation, that so great is the influence of personal convenience, that stores on the lightly frequented side of a street may relatively languish, while stores, no better in attractions, on the densely frequented side may thrive. In other words, it is said that the mere effort of crossing a street by a purchaser will markedly affect his choice of a store. It is the same law in another form which causes the price of a retail article to be often twice and sometimes twenty times as great as the cost of the same article on a larger scale. Where a small quantity of heat is required for cooking, the advantage is altogether in favor of the electric method. A small electric stove is probably as cheap in fuel consumption as a small coal stove, and is devoid of smoke, dust and ashes, besides requiring neither matches nor kindling wood. The electric stove can also be made more compact than the coal stove, and can better retain its heat to the exclusion of surrounding objects, which is a decided advantage in the torrid days of summer. The comparison with an oil stove or a gas stove is less favorable to electricity, but even here the electric stove has the advantage in cleanliness and convenience.

Opening of the U. S. Sections in Electricity Building, Paris Exposition.

IN a quiet and dignified way, the U. S. sections in Electricity Building, in charge of the Department of Machinery and Electricity, were opened on Wednesday, June 6, in the afternoon, the exercises being held in the rotunda of the Salon d'Honneur. Director F. E. Drake, in presenting the sections to Commissioner-General Peck, emphasized the twofold object of the Paris Exposition, to give instruction and pleasure, and expressed the belief that America would be found wanting in neither the artistic nor the engineering development of her industries. He made a brief review of the work that had been done by his department. Mr. Peck expressed himself as greatly pleased with the services of Mr. Drake, and pointed out that his department had had charge of not less than one-third of the whole space allotted to the United States. Mr. J. S. Anthony, assistant director, described the work done in connection with the fine retrospective exhibit, and called attention to its leading features. Mr. F. J. V. Skiff, director-in-chief of the exhibits' department, speaking as an Exposition veteran, said he had never seen better work done around an exhibition than that performed by Mr. Drake and his staff, including the lighting and mechanical features of all the American sections; and Mr. Capehart, director of Liberal Arts and Chemical Industry, presented Mr. Drake with a superb bouquet on behalf of that department and others. Mr. Peck then commended the work of Mr. John Getz, in connection with the façade of the U. S. Salon d'Honneur, and passed on to review the gallery and ground floor exhibits. Mr. Drake seized the opportunity before he did so to speak in praise of Messrs. Anthony, Malcolmson, White, Ball, Rochette, Talbot and others of his staff, to whose efforts so much of the result attained was due.

The general plans of the U. S. section, with lists of exhibitors, have already been given to the readers of this journal, showing about 385 entries in the five classes of the electrical group, or not far short of one-half of the whole, and only a few less than France herself. There is little to add in regard to the lists and plans, except to say that as events progressed, and the building neared completion, some of the exhibitors who were located on the ground floor and had been exposed to all kinds of hardships there, found it better to remove to the bright and airy gallery overlooking the whole foreign power plant. Around the section, on the ground floor, work is still going on incessantly in the fitting up of engines and dynamos, and it must be some weeks before such work can be finished. In the U. S. section itself, things are far more forward, owing to the fact that there are no large units. This absence of big American dynamos and engines is much regretted by every visitor from the United States, but it has at least the compensation of permitting the area to be put more rapidly in order. Up to the present time, the last week of May, no light has been available, except a few service arcs; while the continued cold has rendered the dampness very perceptible and has caused the wrapping up and oiling of a good deal of the valuable machine tools and fine apparatus, of which the American exhibit consists. As the plans will have shown, there are a few machine tool exhibits in the section, but the great bulk is at Vincennes.

Fig. 1.—Lowest Basin, Chateau D'Eau.
(U. S. sections in electricity building lie just within the façade.)

The ground floor sections of the United States and other foreign countries range along under a series of galleries right back of the Chateau d'Eau; and, without light, finish or decoration, remain quite gloomy; but on ascending to the galleries, which are now rapidly approaching completion, a much more cheerful aspect of things presents itself, with a most enjoyable diminution also of dust and noise. A large part of the U. S. section there is occupied by the U. S. Court of Honor, which, as it looks over the rail of the stair landing out upon the foreign power plant, is flanked on its left by a long line of American miscellaneous electrical and mechanical exhibits, very tastefully grouped and arranged. For such concerns as have material too minute, or an exhibit too small, to require an open space for themselves, a row of handsome oak glass upright cases has been provided, in which the exhibits are effectively grouped and displayed. Along the front of this gallery section runs the uniform ornamental iron railing furnished by the U. S. Commission, corresponding to that which also encloses the U. S. block and spaces on the ground floor. Throughout all this part of the Champ de Mars, direct current, three-

wire, at 220 and 440 volts, is to be obtainable, so that lights, motors, etc., are based on that condition. The wires for the service arc lighting are carried along on the metal beams overhead, but the circuits from the dynamos for supplying the various exhibits have all been placed underground and laid, not in conduits, but in the bare earth trenches, into which they were hauled by the main brute strength of gangs of 15 or 20 men. The making of connections and obtaining extra supply of current if required, is, therefore, attended with some little difficulty, although the main switchboards are close by.

The Court of Honor of the U. S. electrical section has already been shown in these pages, and the work upon it, both as to decoration and the grouping of exhibits has been most carefully supervised by Mr. J. S. Anthony, assistant director of the electrical section. The pieces of apparatus, which number several hundred, are, for the most part, mounted in glass cases on glass shelves, and the floor of the space is covered with Turkey red carpet. There is a central circle flanked by four square courts, the circle frustrating one corner of each; and beyond the square block thus constituted lie two long wings. There is an aisle through the middle of the Court and two other aisles pass the wings, so that there is free circulation, a necessary requirement, as every one coming up the stairs from the foreign power plant or entering from the grounds by the inclined pathway from the Chateau d'Eau, or traversing from the Festival Hall and the Agricultural Building, is brought to this point. Back of the U. S. Court of Honor lie the courts of other nations—Germany, Switzerland, etc., with France in the middle.

The Court is 70 ft. deep and has a front just about 100 ft. in width. It is, of course, but one story in height, and, far above its beautiful white façade and inviting corridors waves a huge American flag suspended from the ceiling. Along the crest of the walls of the white façade rise graceful figures carrying lamps, as shown in the engraving, and around the walls are niches enclosing replicas of a female figure by Carl Bitter. The bases of the columns have a conventional pattern, suggestive of the national flag, and the incandescent lamp is worked into the capitals. The keystone of the main entrance has a neat little design in white and gold of the kite, more or less familiar in American electrical history. In the spaces over the arches are other classic figures of graceful young women using the telephone. The tint of much of the statuary detail is a light green and cream. Around the façade are some American shields in color, and a row of small discs or bosses are brought up in relief in silver and light blue, with very pretty effect. The whole Court is illuminated by 500 incandescent lamps of 10 candle-power, carried in ground glass globes along the front or held up by the statuary. Within the more open spaces, seats have been placed, and for the better protection of so many valuable and important objects, gates have been put at each end and plants are scattered around. In addition to this, one of the American guards is always on duty here, supplementing the regular patrol of the Exposition guards; and there is also the lighting from some of the clusters of four arc lamps hung all through the gallery by the

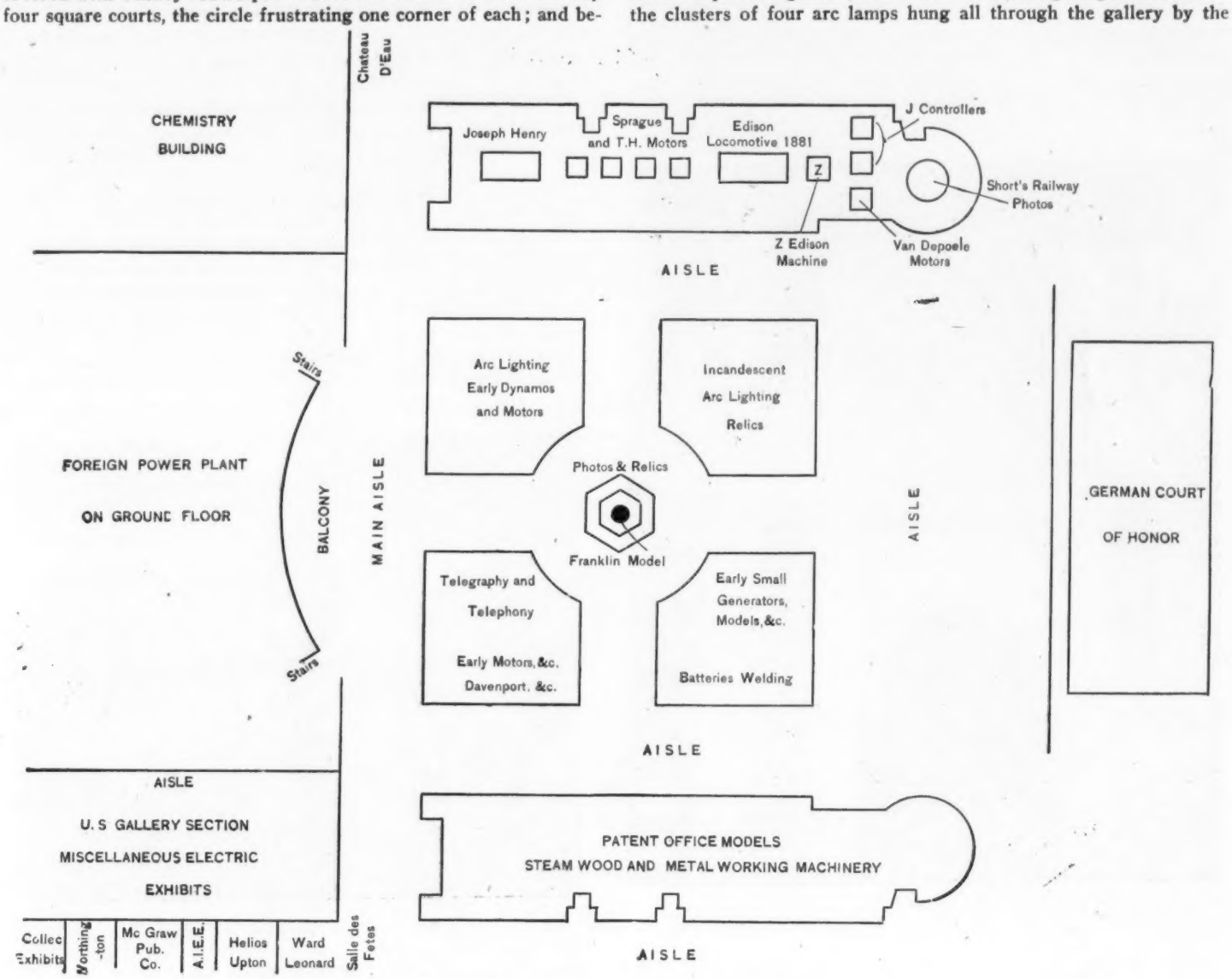


FIG. 2.—PLAN OF AMERICAN COURT OF HONOR.

authorities for general illumination, and carried on curious fixtures of rope and cross-bars.

On the left side, as one faces toward the Court, mounted on a low platform, are a series of early electric railroad and street railway apparatus, including Edison's work of 1881 at Menlo Park; the Joseph Henry of Prof. Short, and the motors of Van Depoele, Sprague, Thomson-Houston, General Electric, and other inventors or companies. They present a most interesting chapter of development. In the compartments across the front are the earliest relics of incandescent lighting in America—the first lamps, sockets, fuses, etc., and the first chandelier ever used for electric lighting, loaned by Mr. Luther Stieringer, with its exterior circuits of red and blue wire to indicate the polarity. There are also early arc lamps of Wallace, Brush, etc., and the first Jandus enclosed arc put into commercial use. With these go naturally some very early Brush arc lighters, dating back to 1878, and an early one of Prof. Elihu Thomson, with details of regu-

lation, commutation, etc. There are also shown an early Thomson searchlight, early examples of alternating-current apparatus, and some of Prof. Thomson's earliest examples of the meters now so widely in use. The wing on the right is occupied by a number of mechanical models and relics. Dr. R. Ogden Doremus contributes some remarkable relics of early battery work—a good 50 years old—including his gas carbon in one piece weighing 83 lbs., and one of his original Bunsen cells used for lectures, power purposes, etc. In sharp contrast to these are the little Lundell motors run in New York by the current from Niagara at the Exposition of 1896.

When one turns to telegraphic and telephonic apparatus, there is an equally fine collection of objects of genuine value and importance. The American Bell Telephone Company, for example, has sent some of its earliest pieces of Bell apparatus, and the Smithsonian Institution has contributed liberally from its relics of Morse, Farmer, Henry, etc. These, again, are supplemented by a choice collection of models from the U. S. Patent Office, including Edison's printing telegraph, Elisha Gray's, the Gray telautograph, etc. The Smithsonian sends also memorials of Page's railway work, and the Patent Office has models of small motors by Weston, 1878; Thomson, Edison, Page, Diehl, Lillie, etc., and generators of Brush, Thomson, Edison,

FIG. 3.—ENTRANCE TO U. S. COURT OF HONOR, ELECTRICITY BUILDING.

Weston, Maxim, Farmer, Hochhausen, Lontin, Pixii, Wood, Eickemeyer, etc. The American Institute of Electrical Engineers has loaned its little model circular electric railway of Thomas Davenport, the Vermont blacksmith, and in the central case of archives are to be seen the first newspapers ever printed by electricity, those done by Davenport, in New York, sixty years ago. The same case includes a variety of other similarly interesting material, such as the first business circular of the Bell telephone, posters of the Farmer electric railway of 1851, portraits, etc.

Some of the duplicate apparatus is well worth mention, such as that furnished by the Smithsonian Institution of the Morse telegraph register, the Morse telegraph key of 1844 and the key of 1845; the Henry "Gale" magnet, the Henry battery of 1832, made to operate his electromagnetic signal, etc. Another choice example in this class is the facsimile of Franklin's electrical machine, made by the pupils of the Spring Garden Institute of Philadelphia, and placed prominently in the rotunda.

Among the details of electrical apparatus, etc., are many features of interest, such as those from the General Electric Company relating to trolleys and the insulation and support of trolley lines, rheostats and controllers in their early forms, fuse boxes, etc. Perhaps the most striking part of this class is the agent's sample case, with which customers were coaxed into subscribing for the Edison central-station service in New York in 1881-2, making one marvel at the skill of the canvasser and the easy submission of his victim. In sharp and effective contrast, but only one further chapter in the same industrial development of electricity, is the superb set of forms, blanks, records and bookkeeping system loaned by the Chicago Edison Company as illustrative of what is necessary in dealing with its enormous income from current supply and in keeping tab on its thousands of patrons for electric light, heat and power, who need little coaxing, and whose demands for current cause incessant increases in the capacity of the plant.

The staff of the Department of Machinery and Electricity consists of Francis E. Drake, director; James S. Anthony, assistant director; Walter R. Talbot, chief clerk; W. D. Ball, C. T. Malcolmson, W. E. Weinsheimer and F. W. Geissenhainer, electrical engineers and experts. In addition to these, is Mr. E. C. White, superintendent of the American Machinery Building at Vincennes. Mr. E. B. Moore, chief examiner, U. S. Patent Office, is also in attendance, in connection with the exhibit of the electrical and mechanical models from that department, there being over 200 of them. Mr. Malcolmson has lately been placed in full charge of all the engineering work of the department.

The Hall of Congresses.

Not one building at the Paris Exposition touches more interests or more sides of life than the Hall of Congresses, which is shown in an accompanying picture. Not only will all the congresses already beginning be held within its walls, but a large part of its space is devoted to exhibits in social economics. The building is a handsome, large white structure of classic design, close to the Alma Bridge, and looking across the Seine to the Street of Nations. This waterside front is highly ornamented with statuary and plaster moulding on the

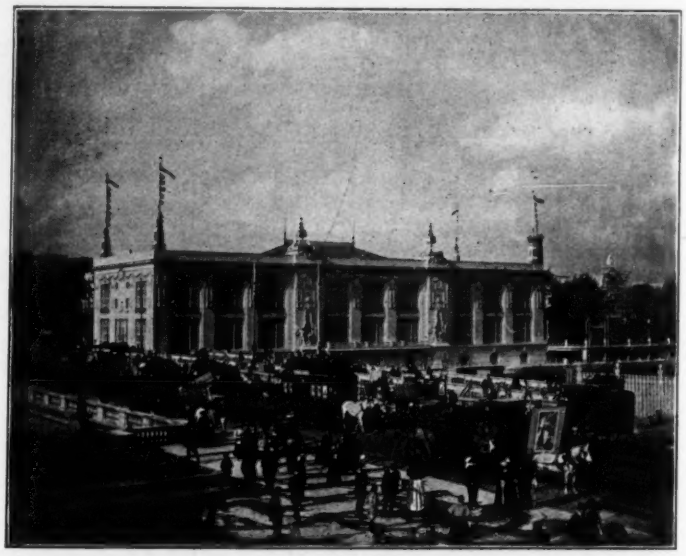


FIG. 4.—HALL OF CONGRESSES.

walls, while the rear side opening on the gay Rue de Paris, which comes very near to being a repetition of the Chicago Midway, is quite plain and severe. The cornice of the building is picked out at night by a line of incandescent lamps.

In the basement of the building various schools and classes have been established having more or less connection with the Exposition. The ground floor is taken up by the social economic sections of the different countries, and with bureaux and exhibits relating to life insurance, co-operation, trades unionism, trade guilds and societies, etc. The United States section is one of the most compact and instructive of all, owing to the careful manner in which the material has been compiled and massed. There is a large series of charts devoted to the illustration of the development of the country in trade, manufactures, production, etc., and one of these shows by colored dots, stars, etc., the electric lighting system as it stood in 1899, so far as relates to central-station plants operated by private companies, or by municipalities, whether consolidated or otherwise, and indicating where towns were lit by transmission from other points. In one set of photographic panels to illustrate conditions of the working people, views are given of the General Electric Works at Schenectady, show-

ing the factory grounds with flower beds, etc.; the lands of the building association and other features. In the same set are some views from J. H. Williams & Co., drop forgers, of Brooklyn, showing the factory, baths for the workmen, etc. The Cleveland, Ohio, Electric Railroad Company has a very interesting set of photographs inclusive of the Miles Avenue depot, the bowling alley of the Hohenden Avenue club-room, and the club quarters at Miles Avenue, Wilson Avenue and Lake View. In another series of these panels, which attract much attention as the faithful presentation of things as they exist in far-off America, are a fine set of photographs of the shops at Pittsburg of the Westinghouse Electric & Manufacturing Company, and the Dixie tannery in Tennessee of Chas. A. Schieren & Co.

Two broad flights of stairs lead to the upper floor, and there are situated the conference rooms, designated by letters; as well as a vast open space with tables and low leather benches. The latter hall, it would appear, can be divided up, if necessary; a condition likely to arise, as the demand for congress dates is pressing, and no small part of the space is in permanent occupancy by various societies. Plans which contemplate a long sitting on the part of any single congress are likely to be curtailed. Note has already been made in these pages of the congress features, but it may be well to recapitulate here the fact that between May and October over 70 congresses are to be held, of which 19 relate to science and allied industries. They are listed as follows: Steam engines and machinery, July 16 to 18; applied mechanics, July 19 to 25; applied chemistry, July 23 to 31; physics, Aug. 6 to 11; electricity, Aug. 18 to 25; street railways, Sept. 10 to 12. It may be doubted whether some of the above will occupy the full time stated; in fact, the French members state that their duration will be much briefer than the dates indicate. There is no doubt, however, that a large amount of good work is being laid out for swift despatch in these international gatherings.

Electricity in the American Publishers' Building.

One of the buildings of most interest to American manufacturers and engineers was opened on May 31, namely, that known as the American Publishers, situated at the rear of the foreign Varied Industries Palace on the Esplanade des Invalides. The place is not hard to find, as it is overlooked by both the moving sidewalk and the third-rail road. It is a low, single-story structure, consisting of a

FIG. 5.—AMERICAN PUBLISHERS' BUILDING, ESPLANADE DES INVALIDES.

square building enclosing a series of domes supported by massive ornamental columns, out of which the treetops spring above the roof, the light by day coming from the domes and by night from five rows of seven handsome fixtures in red, black and gold, each of the thirty-five carrying five incandescent lamps. The general scheme and style of decoration may be described as Oriental. This building is in reality an annex to the Department of Liberal Arts and Chemical Industries, and its contents should by every right be over on the Champ de Mars as part of the American section in the Liberal Arts Building there, in juxtaposition to the superb French exhibit of printing and publishing; but once again the exhibit from the United States has suffered as to location on account of the exigencies of

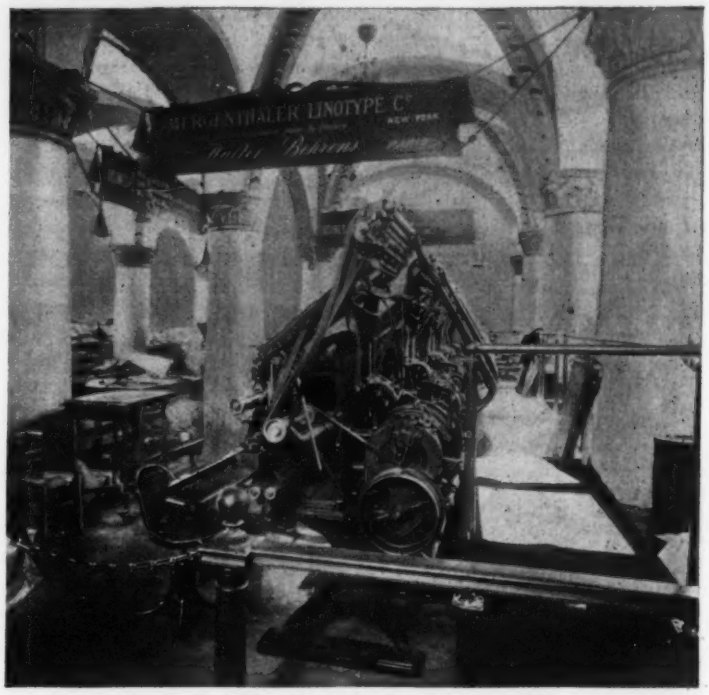


FIG. 6.—GANG OF LINOTYPE MACHINES, WITH LUNDELL MOTORS, AMERICAN PUBLISHERS' BUILDING.

space. However, the building and its contents are most creditable to American printing-house machinery interests and to the various publishing and other allied concerns that have freely contributed to the collective display.

Electricity as a motive power cuts a most important figure throughout the exhibit. The central feature is a large Goss straight-line press, which is used by the *New York Times* for printing its daily edition, and this is driven by a Bullock motor of 30 horse-power placed under the floor at the side of the bed, and working at 500 r. p. m. The well-known Bullock "teaser" system is employed, and the plant has been carefully installed by Mr. W. B. Spellmire on behalf of Bergtheil & Young, the agents for the Bullock Electric Manufacturing Company. The motor is direct current, 500 volts. The press prints 48,000 eight-page papers an hour, and the unit runs with beautiful smoothness, the motor allowing a variation of one-twentieth speed up to full.

In addition to this, there is a Cottrell press driven by a Lundell motor of 7½ horse-power; a Miehle press driven by a 5-hp Triumph motor; a Babcock press driven by a Crocker-Wheeler 3 horse-power; a Campbell press driven by a Bergmann-Burke belted motor, and a Harris press driven by a belted Sprague motor. In addition to these are a number of small presses, paper cutters, etc., driven by General Electric, Crocker-Wheeler, Diehl and other motors, and there is a gang of five Linotypes, each driven by a Lundell motor from the Sprague Electric Company, the motors being ingeniously mounted in a bracket on the machine in a manner which evokes much admiration from foreign visitors. There is also an exhibit of the method of electro-deposition as applied in the printing and publishing industries.

The building is in charge of Mr. A. S. Capehart, Director of the United States Liberal Arts section, and of Mr. Charles H. Sinnus, Assistant Director, who have striven to make it a headquarters and meeting place for publishers, etc., and who have been very successful in their efforts. One part of their exhibit is a collection of the bound volumes representing the latest sets of leading American periodical publications, and among these are to be found the ELECTRICAL WORLD AND ENGINEER, the *Street Railway Journal, American Street Railway Investments* and the *Americal Electrician,* in handsome bindings. The building also receives copies of these journals regularly for the files in the care of Mr. A. H. Mattox, the press representative. This exhibit of publications has been grouped in a separate pretty little

annex called the Business Men's Club. It serves as a connecting link between the Publishers' Building and the United States section in the foreign Building of Varied Industries, and the pathway spaces intervening are to be covered in summer with an awning, so that an air of continuity will be given to this whole American part of the show. In this manner the displacement of the publishing section from its proper place on the Champ de Mars, in Liberal Arts, has been overcome as a detriment. The little clubhouse is most attractive, and the bound volumes and files are well displayed for handy use, the former being in Wernicke box bookcases and the latter in clips.

The question of current for the Publishers' Building was most serious. Owing to the fact that none is yet available from the service plant, it looked as though there must be an indefinite postponement of opening, but American energy and ingenuity were once more equal to the difficulty. The current to be supplied all through this section is three-phase, which in the Publishers' Building was to be used for lighting, while it would be transformed for power to direct. Through the active intervention of Messrs. Arthur Warren and Maurice Coster, of the Westinghouse Company, this plan has been carried out by drawing on the Westinghouse street railway plant at Moulineaux. The lights are run on its 5000-volt three-phase current taken through

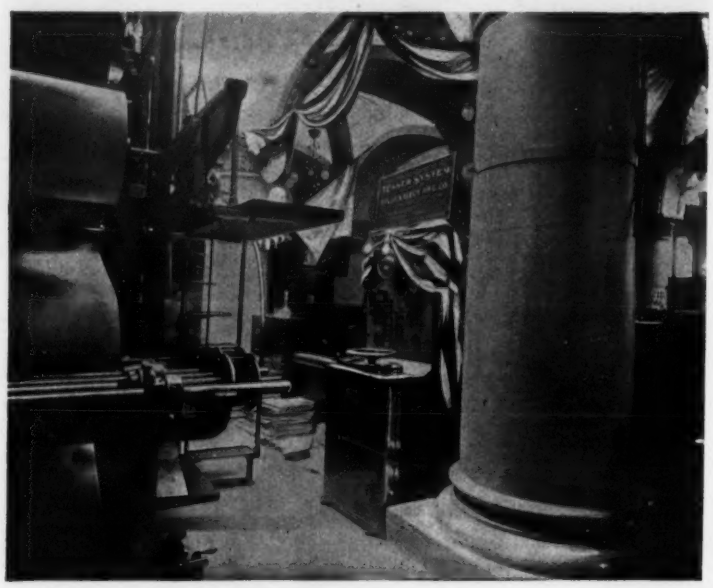


FIG. 7.—NEW YORK "TIMES" PRESS, BULLOCK MOTOR. AMERICAN PUBLISHERS' BUILDING.

a static transformer. The direct current at 500 volts for the larger motors is taken by a tap from the circuits of the moving sidewalk and third-rail road, and there is a neat Crocker-Wheeler dynamotor outfit of 23½ amperes which steps down the 500 volts to 110 volts for the smaller motors. Thus every installation is enabled to operate, and a perplexing situation has been adequately met, to the great relief and satisfaction of all concerned.

The Moving Sidewalk at the Paris Exposition.

ALTHOUGH it has been in operation but a few weeks, the moving sidewalk at the Paris Exposition has proved a great success. In fact, it has been indispensable, for the third-rail service can hardly be said to have been put in service at all during April; so that during the first fortnight of the Exposition all the burden of travel within the grounds was thrown upon it. The exact data of patronage is not given out, but when the gross attendance runs up to half a million on Sunday, it can be safely inferred that not less that day than 150,000 people avail themselves gladly of this novel and ingenious means of locomotion. It is already one of the distinct hits of a show replete with features of unusual interest and whether adopted or not elsewhere, is an admirable illustration of the powers of electricity, which can even make a sidewalk laden with crowds get up and circulate.

The experiments as to the possibility and utility of this system for the Exposition were carefully made by the authorities nearly two years ago, being recorded in these pages by M. Georges Dary in July, 1899. The work is that of the Compagnie des Transports Electriques de l'Exposition, and the trials undertaken out at Clichy on a quarter-mile track are now being renewed under the most exacting conditions of real transportation business on an elevated track about 2½ miles long, completely encircling the parts of the Exposition that lie on the left bank of the Seine and touching at their outer edges at nine different stations, the buildings on the Champ de Mars, the Esplanade des Invalides, the Street of Nations and those of the portion of the Quai d'Orsay running up to the Eiffel Tower. It is a great

FIG. 8.—MOVING SIDEWALK CROSSING AVE. DE LA MOTTE PICQUET.

pity that some such service could not have been furnished for the long line of buildings on the right bank of the Seine. People who have traveled by the sidewalk on one side of the river are very much disappointed when they find that on the other side they must walk every inch of the way from far beyond the Trocadero down to the Monumental Gate on the Place de la Concorde—unless they take rolling chairs driven by man power.

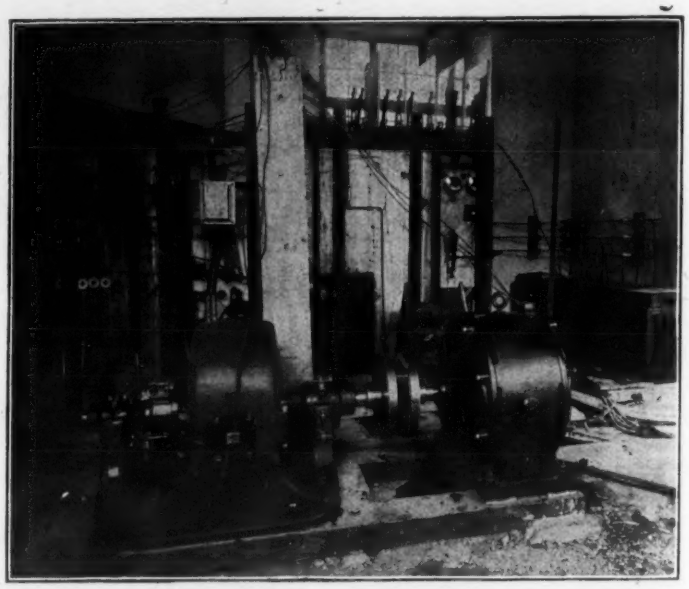


FIG. 9.—MOTOR-GENERATOR OF THE MOVING SIDEWALK PLANT.

In one great respect of convenience, however, the Paris sidewalk differs from that of Chicago in 1893. It has no seats, except on the part of the structure which does not move, and visitors are beginning to find this out and take their own stools and camp chairs, although the extent to which these will be permitted is still an open question. The fast platform at Chicago had transverse benches with a seating capacity for 6000 persons. The Chicago sidewalk was so unfortunately located on the remote Casino Pier that it may be doubted whether any such number ever wanted to try the thing all at once.

but the seats were there, while at Paris they are entirely wanting. For purposes of comparison in other respects, some of the readers of this journal may be glad to be reminded that the Chicago moving sidewalk was about 4300 feet long, and had, like that at Paris, two traveling platforms, one operated at three miles an hour and the other at six, the slow platform being practically an outboard structure with trucks supporting also the fast platform. The upper, fast platform to which one stepped easily from the other, constituted the main feature. It was carried upon two rails resting upon the tops of the wheels of the trucks forming an integral part of the slow-speed platforms. These rails, 4 ins. deep and ½ in. thick, were simply flat bands of steel, flexible and endless, the pieces being welded into lengths of 130 feet, and then those riveted. Fastened to the under side of this upper platform were brackets in each of which was placed a block of rubber to serve as a spring, and bearing upon that was a shoe made of case-hardened steel, fitting loosely over the rail and gliding or slipping slightly on it as the cars left or entered the curves. There was no expansion joint in the whole 4300 feet. Drawheads kept the upper fast cars properly spaced, the interlocking being such, however, as to make the platform continuous. There was no tension on the upper cars or platform, due to tension, as in the case of the lower trucks. The upper platform moved as a unit at

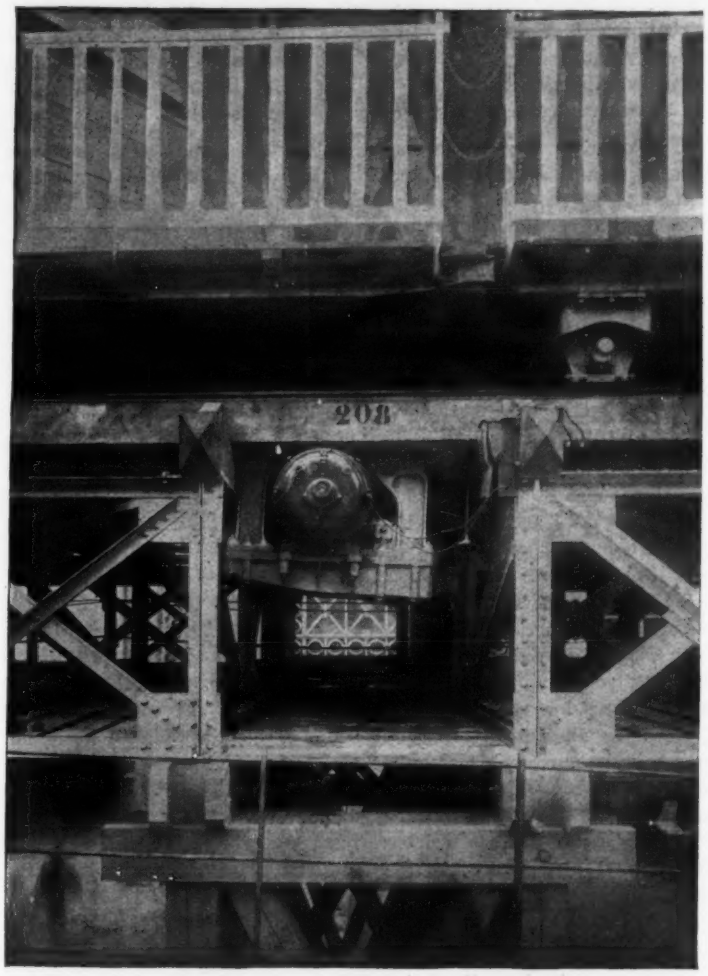


FIG. 10.—WESTINGHOUSE MOTOR OF MOVING SIDEWALK.

exactly twice the speed of the lower under all conditions, as its speed was equal to that of the periphery of the wheels, while the speed of the trucks equaled that of the axles. Every thirty-fifth truck was built of steel and carried an equipment of two General Electric double-reduction motors of 15 horse-power each, there being 10 motor trucks in all. Current was supplied by the Exposition authorities up to a limit of 300 horse-power, but it is said that the work was never such as to require even more than 200 horse-power.

It will be obvious at once from a glance at the diagram and cross section of the Paris sidewalk that a very different method has been there adopted. In the Chicago instance there was virtually a train in motion, with distributed motors, and picking up its current from a third wire or rail, so that the analogy was closer with a moving set of flat cars than with a sidewalk. At the Paris Exposition the motive power is wholly dissociated from the driven, traveling structure, and there is presented a system which operates as though a locomotive or a series of motor car trucks were lying upside down and driving by friction an inverted roadbed passing over them, the traveling platform resting on the circumambulatory rails.

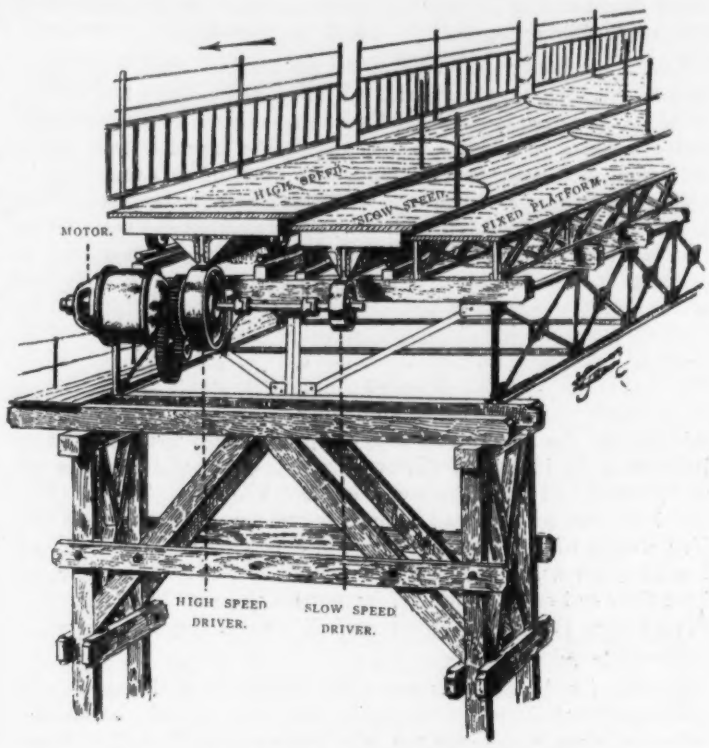


FIG. 11.—MECHANISM OF THE ROLLING PLATFORMS.

The road is supported by a stout wood and steel construction built into concrete and as a general thing serving as a roof to the third-rail Exposition road just as the elevated roads in New York and Chicago do to the street cars beneath them. Here and there the third-rail road rises to the level of the moving sidewalk, as, for example, along the whole length of the Avenue de la Motte Picquet, and then dropping below the surface a bit; and at no point in the whole circuit does one interfere with the view from the other. There is very little grade to

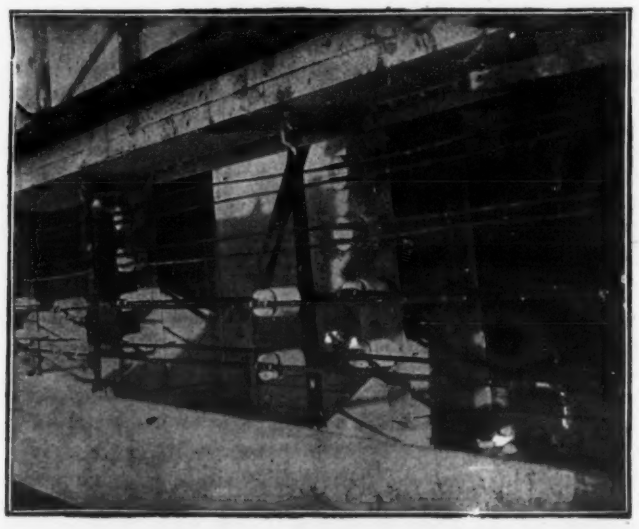


FIG. 12.—DETAIL OF MOVING SIDEWALK CONSTRUCTION, WITH CIRCUITS.

the sidewalk, although its height from the ground varies from 12 to 24 ft. in order to leave a minimum of 15 ft. clear at street crossings, for on the walk one dodges in and out of the Exposition in a really extraordinary manner, at one minute passing Electricity Building, then confronting the second-story windows of a bustling avenue, and once in a while looking down on omnibus tops or the little steamboats

of the Seine. The structure is fenced in its entire length, neatly painted, and furnished with no fewer than nine stations all grouped on the three sides actually within the Exposition grounds. Here on the stations people can wait for friends or rest, and there is also a continuous footpath upon which passengers frequently get off for a minute or two to look at some particular building. At more than one point, the whole structure is embowered in trees, whose shade is already discovered to be most grateful as a relief to the glare of the long white shining façades.

Spaced out under the structure are the brackets for the propelling motors and their trains of gear. Of these motors, of 5 horse-power each, there are 120 built at the Havre shops of the French Westinghouse Electric Company. These motors are ironclad type, double reduction, four-pole, series wound, and operated in parallel at 500 volts. As will be seen from the sectional view, the same shaft from the train of gearing carries both the pulleys or driving wheels for the two platforms, but either platform can be moved independently by pressing up into frictional contact with the rails, the pulley wheels of the one it is desired to operate. The slow-speed platform, placed next to the stationary footpath, moves normally at a speed of 2¼ miles an hour, and the high-speed platform at 5½ miles; while with the motors grouped two in series throughout, a half of these speeds is obtained. The rate of revolution of the drivers is 73 turns per minute, and the motors run at 275 r. p. m. With tests made at the half-speed, the low-speed platform running empty was found to take 90 kilowatts and the high-speed about 200 kilowatts. The weight of the slow when without load is, roughly, 700 tons; or 1000 tons loaded. The weight of the high-speed platform unloaded is 1500 tons and loaded 2300 tons. The motors are handily placed for inspection, and have their end cases perforated for purposes of ventilation, but in all other respects they are weatherproof. The work they are doing is of a most satisfactory nature.

Current for the sidewalk is supplied from one of the several outside sources employed to supplement the service plant of the Exposition, it being in this case the Westinghouse electric railway power house at Issy-le-Moulineaux, near Billancourt. For both the sidewalk and the third-rail system, there is a fine transformer station on the Exposition grounds just where the lines curve around from the Quai d'Orsay into the Avenue de la Bourdonnais, and 5000-volt three-phase current is taken straight from the exterior circuits into a Westinghouse induction motor, the largest ever built, it is said, being no less than 850 horse-power. A very full account of the two handsome machines of this type, built at Pittsburg for the plant, was given in the Electrical World and Engineer of March 3, 1900, with illustrations. Either unit of this type is adequate for both the sidewalk and third rail, and is direct-connected through an insulating coupling to a Westinghouse generator of 600 to 700 kilowatts, which delivers continuous current to the track at 550 volts. The speed is 290 r. p. m., and each machine weighs 29 tons. Although the completion of the power plant was delayed by the loss of part of the apparatus on the Pauillac, Messrs. Schmid and Coster, of the French Westinghouse Company, dealt with the difficulty vigorously, and now have the plant in splendid condition. One of the induction motor units stands at each end of the power house, with a handsome switchboard in between, and there is a large complement of static transformers for various uses. A full account of this interesting plant will be given later.

In connection with the big unit is a smaller one for starting and exciting purposes, and comprising a 40-hp three-phase motor supplied through three adjacent transformers. To this is direct-connected a 30-kw direct-current generator, 550 volts. Current is taken in by the motor first at 168 volts, and as the speed increases a little manipulation at the switchboard raises the e. m. f. to 220 volts and brings the speed up to normal. This generator in turn starts up the larger unit, running the direct-current end as a motor to bring the induction end up to speed so that it can be thrown upon the 5000-volt circuits. Either of the two exciting units that will ultimately be installed is of sufficient capacity to start up a generator thus or to excite both generators at the same time. In starting up the sidewalk, the voltage of the direct-current generator is held very low, all switches and circuit breakers in the feeder circuits are closed, and then the circuit breaker and the single pole switches in the generator circuit. The resistance of the field rheostat is taken out gradually and slowly, increasing by easy stages the voltage of the generator and also of the motors driving the two platforms, until at last full speed of the sidewalk is attained. When the voltage of the generator is equal to that of the exciter a switch is closed, and by operating another switch the generator becomes self-exciting. Then the exciter switch is opened and that part of the system can be cut out and shut down. As already stated, the two walks can be run independently, and there is a flexibility about the whole system which enables the generating plant to get to work quietly and without strain. The separate excitation of the generator allows a range from 50 up to 500 volts in the field, and the smooth and gradual starting of the motors and sidewalk is a necessary consequence.

With regard to the induction motors thus shown, and creating no small amount of well-deserved attention among all the engineers visiting the Exposition, it may be added that the primary element is a hollow cylinder built up of laminated rings of sheet steel mounted on the inside to receive the conductors. The rings are segmental and fit into corresponding slots in a hollow cylindrical shell of cast iron, which is held in the cast-iron frame of the motor. The conductors are machine-wound coils. The secondary or armature element of the motor is built up of laminated steel discs mounted upon an open spider and around the slotted periphery are the rectangular copper bars that constitute the winding. The motors are 10 pole and operate at 3000 alternations per minute. The power-plant out at Billancourt now in process of construction or enlargement, has already two generating units at work and one being got ready, all being 800-kw three-phase, revolving field alternators, at 5000 volts. The field has 38 poles and the armature three slots per pole per phase, or 342 slots. Six such generators are the immediate intention, and yet three others will be added later, as the plant is to be a great centre of current supply for electric railway work.

The sidewalk is put into operation every day at 10 a. m. and runs until 7 p. m. When the Exposition is open nights these hours are extended, as there is a large amount of patronage offering. People begin riding as the "flag falls" and some of them stay a long time. The fare is only 10 cents, and you can travel all day if you wish. All kinds of curious experiments by the passengers can be observed. The platform travels the reverse way of the hands of a clock, that is, it moves from right to left. Although the platforms are in motion, everybody walks, and some carefully time themselves to see how quickly the tour can be made. Others try walking backward, that is, the reverse way of the walk, and it is commented by a few that the motion engenders in them a sensation something like seasickness. This is probably due to a slight giddiness caused by passing so many other people and objects, for the movement itself is very equable and steady. As already noted, there are no seats on the moving structure, nor is there any shade awning. A view of it is shown in Fig. 8, taken from the street at a curve. There are numerous polite officials, who take kindly to the task of showing novices how to get on and off, or change from one platform to the other. Many people cling all the time to the guiding posts painted white with red knobs, or grab at them eagerly just as one does on the hand-rail of a passing car, to mount. The sidewalk makes a dull, rumbling noise due to the pulley wheels, but the sound soon becomes familiar, and in no wise interferes with conversation. It is possible that the inhabitants along the line where it passes near the fronts of their houses get rather tired of the persistent noise, but the walk does not run all through the night, which is a surcease not granted to the dwellers along the Manhattan Elevated in New York.

The sidewalk is an undeniable hit, and all Paris is talking about it. But the practical question arises: Will it pay? To answer this important and, after all, vital question, it may be stated that the cost of installing the sidewalk and operating it during the seven months of the show is put at about $1,500,000. The price of admission is 10 cents, so that the cost would be covered by 75,000 passengers a day, or $7,500 daily for 210 days. The rated capacity of the walk is 60,000 passengers per hour, and the Exposition when in full blast is to be open 14 hours a day. At present the attendance at the show is averaging from 100,000 up to 500,000 daily, and it would certainly seem to the casual observer that most of the people want to try the sidewalk first of all. A large number use it for travel in their regular exhibition work. The walk has, of course, to meet the competition of the third-rail service at 5 cents a ride, but it is the great novelty, the ride that can last all day, and the passenger is up in the open air and sunshine in full view of all the buildings and vistas of the show. If the salvage of so large and fine a plant be taken into consideration —and perhaps without it—there would be a fair, if not a large return on the investment in this most interesting enterprise. It is demon-

strating in a most useful and successful manner newer methods of transportation for which there is need, and which a few years hence may perhaps have become as general and commonplace a part of civilized life in cities as the trolley car and the telephone.

NOTES.

MEANS OF TRANSPORT JURIES.—In group 6, civil engineering and means of transport, the juries have organized in the several classes. In class 30, including automobiles, the officers are: President, M. Cottenet; vice-president, Major Howard; reporter, M. Forestie; secretary, M. Copeau. In class 32, including railway material and street railways, the officers are: President, M. Lethier; vice-president, M. Ludwig; reporter, M. Salomon; secretary, M. Colin.

MR. OSCAR T. CROSBY was suggested and most favorably considered as one of the jurors in the electrical classes, owing to his residence in Paris and his perfect command of the French language, not less than his intimate technical acquaintance with the subject. On inquiry as to his present location, however, it was found that the last word received from him by his family here was that he was at Singah, a place apparently somewhere in the French Soudan, and was then traveling in parts unknown. It was evident that his services could not be commanded.

MR. GUIDO SEMENZA, engineer of the Milan Edison Company, and correspondent in Italy for the McGraw Publishing Company, has been made one of the jurors for his country in the electrical group. He arrived in Paris the first week in June to take up his duties, and was much gratified to find so many Americans whose acquaintance he had made while investigating the conditions of electrical engineering work in the United States in his trip of 1899.

ENORMOUS ATTENDANCE.—At the present rate, the attendance at the Paris Exposition bids fair to run up close upon fifty millions. For Whit Sunday and Monday the total was 1,030,368, and the following Tuesday it was 215,000, the regular daily rate mounting steadily. From the opening of the Exposition on April 15 up to June 5, there have been over 8,000,000 admissions. The moving sidewalk on Sunday carried over 157,000 at 10 cents a head, and the third-rail road ran a train every minute. Exhibitors are greatly pleased at the outlook, seeing that the show is still far from ready. There is a great outcry against the charge of two tickets for entry at night, when everybody wants to see the illuminations, and the management is about to reduce the tariff. So far, little of Electricity Building has been visible to the public at night; but it is hoped that that also will soon be changed.

POOR TRAVELING FACILITIES.—The Exposition crush of Whitsuntide week has brought out sharply the utter inadequacy of the present transportation system. One night the huge and weary crowds waiting for the casual car and occasional omnibus stormed the bureaux where numbers are given out, and then stormed the vehicles themselves, with much breakage of glass and adding to the hours of delay already experienced. The papers are full of it; yet the omnibus people can hardly be blamed, as with the Metropolitan underground coming into use, they have been neither allowed nor willing to increase their rolling stock. To add to the misery, nearly 1000 cabmen went on strike, and others found it easy to insist on higher fare. A trial run was made successfully this week of the Bastille-Vincennes section of the underground, but it is likely to be some time before it will be of much use to the long-suffering Parisian public, now at its wits' end for decent transit.

THE OFFICIAL CATALOGUE of the electrical section is at last out—eight weeks after the opening of the show. It is in two parts, for which 60 cents is charged. One part is the list proper, with a review of each group, as to the history and state of the art. The other bulkier part is thrown in for mere padding it would seem, as it contains a vast amount of matter that is chiefly advertising or non-electrical. The list part is not paged continuously, but contains about 165 pages, with some good maps and plans of spaces. This catalogue is in French, and, so far as known, nothing official has yet appeared in any other language except the special catalogues issued by the different countries as to their own exhibits. These are often useful, and in many cases are well done. Out of 1053 entries, the United States has 385. This is, of course, the strictly electrical section—group 5—and does not include automobiles or transportation, or a great variety of other electrical exhibits to be found in the sections of mechanics, education, chemistry, liberal arts, etc. Catalogues are expected in other languages, but he would be a bold man who set a day for their issuance by the Exposition printers.

Condition of Maximum Efficiency of Transformers.

BY F. G. BAUM.

IT has been noticed that transformers usually give a maximum efficiency at that load at which the hysteresis and ohmic losses are equal, and it has been said* "it would appear that generally in all transformers maximum efficiency will be obtained when the iron and copper losses are equal." A short and simple proof of this general rule is here given. The efficiency of any transformer at any load may be represented by the equation,

$$\epsilon = \frac{E\,I - I^2 r_2}{E\,I + I^2 \frac{R_1}{n^2} + W_e} \qquad (1)$$

E is the total induced secondary pressure (practically constant).
I is the secondary current.
r_2 is the secondary internal resistance.
R_1 is the primary internal resistance.
n is ratio of transformation, and
W_e = total core losses, practically constant.

Deriving $\frac{d\epsilon}{dI}$ and placing equal to zero, as our condition for maximum efficiency, we obtain, after some transformation:

$$\frac{2\,I r_2 - E}{E} = -\frac{I^2\left(r_2 + \frac{R_1}{n^2}\right)}{W_e} \qquad (2)$$

Adding one to both sides gives us:

$$\frac{I r_2}{E} = \frac{W_e - I^2\left(r_2 + \frac{R_1}{n^2}\right)}{2\,W_e} \qquad (3)$$

Now, Ir_2 is the internal loss in pressure due to ohmic drop, and the denominator E, is the total induced secondary e. m. f. As the regulation of good transformers is better than 3 per cent on non-inductive load, the left-hand member has a maximum value of .03—that is the ratio of

$$\frac{W_e - I^2\left(r_2 + \frac{R_1}{n^2}\right)}{W_e}$$

is a very small quantity and practically equal to zero.

This gives us:

$$W_e = I^2\left(r_2 + \frac{R_1}{n^2}\right)$$

That is, the maximum efficiency of any transformer will be obtained for that load which makes the iron and copper losses equal.

To be strictly accurate equation (3) is:

$$\frac{C_e - I^2\left(r_2 + \frac{R_1}{n^2}\right)}{2\,C_e} = \frac{p}{100}$$

in which p is the percentage regulation. This gives:

$$C_e = \frac{I^2\left(r_2 + \frac{R_1}{n^2}\right)}{1 - \frac{2\,p}{100}}$$

as the relation between the iron and copper losses for maximum efficiency. With a regulation of 2 per cent, the copper losses should be 96 per cent of the core losses.

* Transformers, by Gisbert Kapp, p. 92.

Electricity in Western Australia.

The curse of western Australia is lack of water, which kept it a wilderness while other portions of the island continent were being developed. Since the discovery of gold, several years ago, however, there has been a great influx of population, and the flourishing city of Boulder, 400 miles in the interior, has sprung up like a mushroom, and for some time has had an electric lighting plant. The difficulties under which the plant operates may be surmised from the statement that water costs $2 per 100 gallons, and that though the engine exhaust is condensed by passage through a cooling apparatus, the water bill for the plant of 30 kilowatts is $500 a month. At present a pipe-line 400 miles long is being constructed, through which water will be pumped from Perth on the seacoast. Electric power is rapidly coming into use for mining purposes throughout the gold district.

Elements of Illumination—V.

BY DR. LOUIS BELL.

TO begin with, reflection is of two kinds—in their essences the same, yet exhibiting very different sets of properties. The first may be best exemplified by the reflection which a beam of light undergoes at the surface of a mirror. The beam strikes the surface and is reflected therefrom as sharp and as distinct as it was before its incidence and in a perfectly definite direction. The character of this regular reflection is very clearly shown in Fig. 1. Here *B* is the reflecting surface—a plane polished bit of metal, for instance. *AB* is the incident ray and *BC* the reflected ray. In such reflection two principal facts characterize the nature of the phenomenon. In the first place, if a perpendicular to the surface of the mirror—as *BD*—is erected at the point of incidence, the angle *ABD* is always precisely equal to the angle *CBD*. In other words, *the angle of incidence is equal to the angle of reflection*, which is the first law of regular reflection. Moreover, *the incident ray AB, the normal to the surface at the point of incidence BD, and the reflected ray BC are all in the same plane*. In this ordinary form of reflection, such as is familiar in mirrors, the direction of the reflected ray is a perfectly definite matter, and, in general, although the reflected ray has lost in intensity, it is not greatly changed in color. A polished copper surface, to be sure, shows a reddish reflection and polished gold a distinctly yellowish reflection. Only in certain dye stuffs which exhibit a brilliant metallic reflection is the color strongly marked. In other words, a single reflection from a good, clean reflecting surface does not very greatly change either the intensity or the color of the reflected beam. The angle of incidence affects the brilliancy of the reflection somewhat, but the color only imperceptibly. In the art of practical illumination regular reflection comes into play only in a rather helpful way, and kindly refrains from complicating the situation with respect to color or intensity.

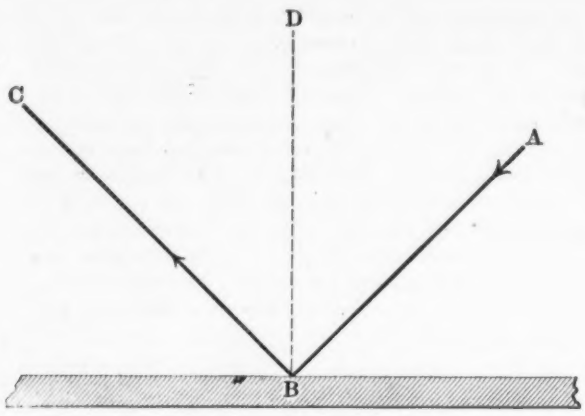


FIG. 1.

The second sort of reflection is what is technically known as diffuse reflection. This term does not mean that the phenomenon itself is of a totally different kind from regular reflection, but, nevertheless, its results are totally different. No surface is altogether smooth. Even with the best polished metallic mirrors while the reflected image is perfectly distinct at ordinary angles of reflection, it is apt to become slightly hazy at grazing incidence—that is, when the incident and reflected beams are nearly parallel to the surface. This simply means that under such conditions the infinitesimal roughnesses of the reflecting surface begin to be in evidence. To get an idea of the nature of diffuse reflection, examine Fig. 2. In this case a section of the reflecting surface is rough, showing grooves and points of every description—in fact, nearly everything except a plane surface. Consider now the effect of a series of parallel incident beams—numbered in the figure from 1 to 10—falling upon the surface. Each one of them is reflected from its own point of incidence in a perfectly regular manner; yet the reflected rays, on account of the irregularity of the surface, lie in all sorts of directions, and, moreover, in all sorts of planes, according to the particular way in which the surface at the point of incidence is distorted. Diffuse reflection, therefore, scatters the incident beam in all directions, for the roughnesses of an unpolished surface are generally totally devoid of any regularity. The point of incidence upon which a beam falls, therefore, radiates light in a diverging cone and behaves as if it were really luminous.

A little consideration of the nature of this diffuse reflection will bring to light a fact which in itself seems rather surprising; namely, that the total intensities of the two kinds of reflection are not so different from each other as might appear probable at first thought—provided the roughness of the unpolished surface is not on too large a scale; for each of the incident rays in Fig. 2 is reflected from the surface just as in the case of Fig. 1, in a perfectly clean, definite way, and there is no intrinsic reason why the intensity of this elementary ray should be any more diminished than in the case of regular reflection. A little inspection of Fig. 2, however, shows that rays Nos. 5 and 10 are twice reflected before they get fairly clear of the surface, and if one went on drawing still more incident rays and following out the figure on a still finer scale, a good many other rays would be found

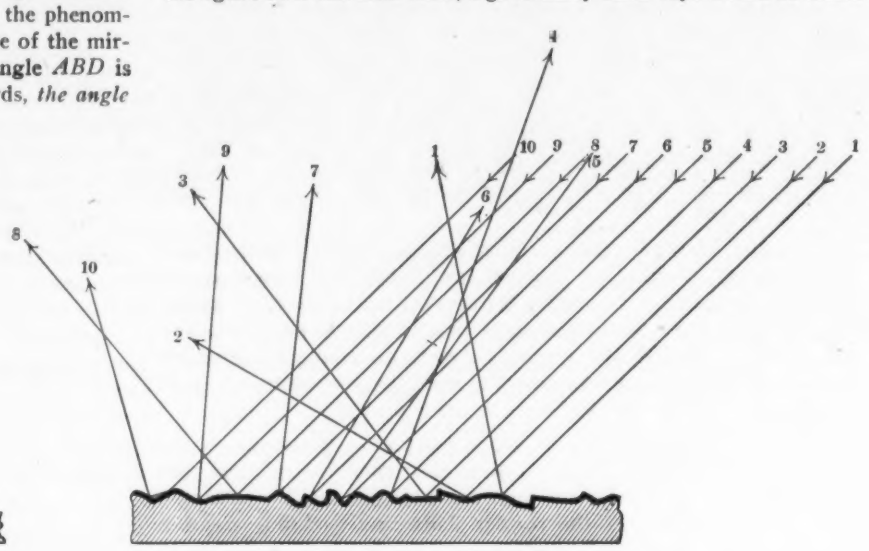


FIG. 2.

to be reflected two or more times before finally escaping from the surface. Such multiple reflection, of course, diminishes the intensity of the light just as in the multiple reflection from mirrors, and there is always a little absorption at any surface however apparently opaque. Thus, while the difference in the final intensities of light regularly and diffusely reflected is not so great as might be imagined, it still does exist and for a perfectly logical reason.

To go into the matter a little further—suppose the rough surface of Fig. 2 to be not heterogeneous, but made up of a series of grooves having cross-sections like saw teeth. On examining the reflection from such a surface we should find a rather remarkable state of affairs, for the course of reflection would then vary very greatly with the relation between the direction of the incident light and the surfaces of the grooves in the reflecting surface. Light coming in one direction, *i. e.*, so as to strike the inclined surfaces of the grooves,

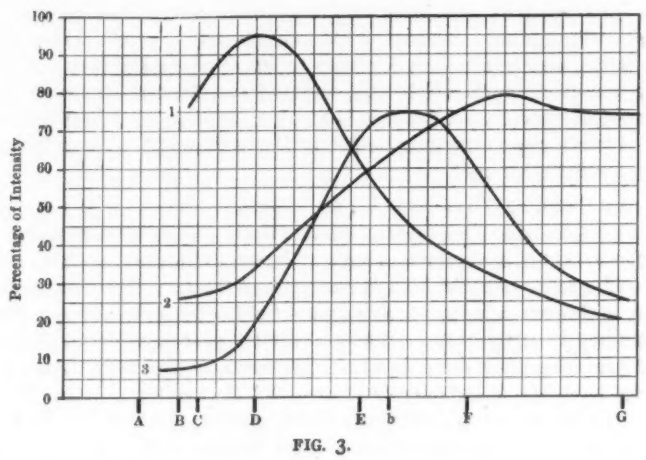


FIG. 3.

would get clear of the surface at the first reflection and the intensity of the reflected beam would have a very marked maximum in one particular direction. A beam falling on the reflecting surface in the other direction, however—that is, on the perpendicular sides of the saw-tooth grooves, would suffer several reflections before escaping from the grooves, and hence would lose in intensity, might be changed in color, and might be considerably diffused. This sort of phenom-

enon one may call asymmetric reflection. As we shall presently see, it plays a somewhat important part in some very familiar phenomena.

Reflection from ordinary smooth but not polished surfaces partakes both of the nature of regular and diffuse reflection and is, in fact, a mixture of the two phenomena, there being a general predominant direction of reflection plus a certain amount of diffuse reflection. This is the sort of thing most commonly met with in practical illumination. The light from artificial illuminants usually falls on painted walls, on tinted papers with surfaces more or less rough, on fabrics and on various rough or smooth objects in the vicinity. If these surrounding surfaces are colored—as in the case discussed a little while ago—some curious results may be produced. Of course, light reflected from a colored surface is colored, as we have seen already, but the manner in which it is colored is by no means obvious.

When white light falls upon a colored surface, the reflection is generally highly selective as regards color. Fig. 3, from Abney's data, shows clearly enough the sort of thing which occurs. It exhibits the intensity of the reflected light in each part of the spectrum when the reflecting surface is colored. The surfaces in this case were smooth layers of pigment. Curve No. 1 is the light reflected from a surface painted cadmium-yellow; No. 2, Antwerp blue; No. 3, emerald green. Each curve shows a principal reflection of the color of the pigment, reaching a rather high maximum value, but falling off rapidly in parts of the spectrum other than that to which the predominant pigment color belongs. As has been already shown, pigment colors are nearly always impure, and this fact is strikingly exhibited in the shape of the curves. It is clear enough, however, what will be the color of the main body of light reflected from any one of these surfaces.

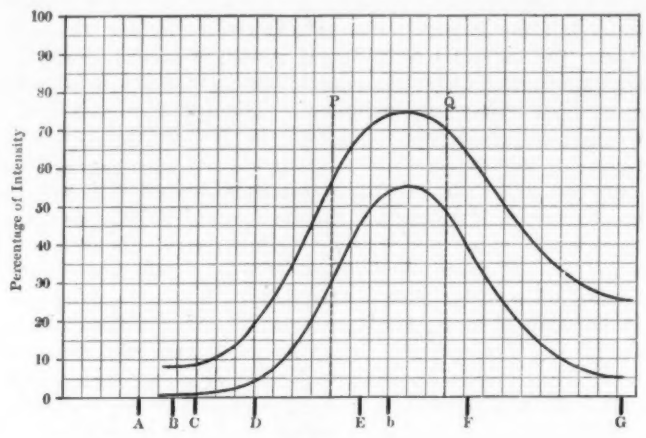


FIG. 4.

The visible color of the light is, however, strongly influenced by the character of the surface. A shiny enamel paint, for example, will reflect a good deal of light which is not strongly influenced by the pigment, but is reflected from the surface of the medium without much selective action; consequently, there will be in the reflected light both light which has taken the color of the pigment and light unchanged in color. In other words, when viewed by reflected light, the pigment color is mixed with white, and when we have a quite simple pigment color—such as is not often found in practice—this would lead merely to lightening the tint. It may, however, have results much more far-reaching—for an admixture of white light in sufficient quantity would shut out the distinct perception of any color, diluting it until it becomes invisible. The effects of this dilution are most marked in the ends of the spectrum—the colors at the middle being least affected by the admixture of white light; hence, the fact that such a surface as we have been considering reflects a mixture of white and colored light, may produce a change not only in tint, but in the hue of the color, if the color, as usual, is composite. For example, a purple in enamel paint might—according to its composition—look pinkish or light blue if the surface reflection of white light were particularly strong. If the pigmented surface is not shiny and hence capable of considerable reflection of uncolored light, another phenomenon may appear.

Fig. 4 shows curve No. 3 of Fig. 3, emerald green pigment, and below it a similar curve, resulting from a second reflection of the light selectively reflected from a pigment of that color. Assuming what is nearly in accordance with the fact—that the second reflection follows closely the properties of the first—the result is obviously to intensify the green of the reflected light. The clear green portion of the light reflected from this particular pigment is practically embraced between the dotted lines *P* and *Q* of Fig. 4. After one reflection the area under the curve embraced by these two lines is about 42 per cent of the whole. After two reflections it has risen to 55 per cent., and each succesive reflection—while greatly reducing the intensity of the reflected light as a whole—will leave it greener and greener. Consequently, in diffuse reflection those rays which are reflected more than once before escaping from the surface are strongly colored, and the more such multiple reflections there are the more pronounced is the selective coloration due to reflection; hence, ordinary colored surfaces, from which diffuse reflection takes place, are apt to take very strongly the color of the pigment—more strongly, perhaps, than a casual inspection of the pigment would suggest.

Now, as we shall presently see, in any enclosed space, the light reflected from the bounding surfaces is a very considerable portion of the whole, and, therefore, if these surfaces are colored, the general illumination is strongly colored also, whatever the illuminant may be; in other words, colored surroundings will modify the color of the illumination just as definitely as a colored shade over the source of light. In looking after the general color tone of a room to be illuminated, if the walls are strongly colored, the dominant tone of the illumination will be that of the walls rather than that of the light.

An interesting corollary resulting from Fig. 4 sometimes appears in the colors of certain fabrics. If the surface fibres of the fabric lie in one general direction, the light reflected from that fabric, which determines its visible color, follows somewhat the same laws laid down for asymmetric reflection, discussed in the case of Fig. 2. Light falling on the fabric from the direction toward which the surface fibres run does not escape without complicated multiple reflection, and hence, takes strongly the color of the pigment. Light, however, falling on the fabric reverse to the direction of the fibres undergoes much less multiple reflection, and is likely to be mixed with a large amount of white light hardly affected by pigment at all; hence, the curious phenomenon of changeable color in fabrics—for instance, a fine purple from one direction of illumination and perhaps light pink from another.

If, in addition to the effects resulting from an admixture of white light in certain directions of incidence, one also has the curiously composite colors sometimes found in modern dye stuffs, the changeable color effects may be and often are very conspicuous; the more so, since in such colors by multiple reflection—or what amounts to the same thing by much more or less complete absorption of certain rays—the resultant color may be very profoundly changed. Absorbing media sometimes show these color changes very conspicuously; as, for example, chlorophyll, the green coloring matter of leaves, of which a weak solution is green, but a very strong solution of considerable thickness transmits only the dark red rays. Similar characteristics pertain to many modern dye stuffs, and result, in connection with the composite reflection which has just been explained, in some very extraordinary and very beautiful color effects.

Test of Belgian Gas Engine.

Several months ago a 4-cycle, 600-hp gas engine, designed to burn blast-furnace gases, was tested at the works of the John Cockerill Company, Seraing, Belgium, with excellent results. On one day the machine was subjected to brake test and on another day operated a blowing engine. The gas used was supplied directly from blast furnaces in the Bessemer mill, which gas is difficult to consume in boilers. In its course from the blast furnace, the gas passed through depositing chambers, where the heavier particles of dust were gotten rid of, and next through a cast-iron box into which steam was injected, the object of the latter arrangement being rather to cool the gas and to increase its density than to free it of dust, the design of the gas engine being such that the latter does no injury in the cylinder. Specimens of the gas taken from time to time were submitted to calorimetric test. The speed of the engine during the first test varied from 92.48 to 94 r. p. m. and the number of admissions was exactly half the revolutions. Calculation showed that the thermal efficiency was 27.11 per cent; that is, this figure represented the ratio between the heat turned into work and the heat available for work. The net efficiency or the ratio between the work at the brake and that of the heat in the gas consumed, varied from 19.86 to 22 per cent, a figure much higher than it is possible to obtain with the steam engine. At full load the thermal efficiency

was between 25.25 and 27.16 per cent, and the net efficiency between 20.44 and 22 per cent. The mechanical efficiency of the machine was 73 per cent at half load and 81 per cent at full load. On the second test the thermal efficiency was 27.34 and 27.10 and the net efficiency 20.60 and 22.17 per cent. Of the total heat supplied 20 per cent was converted into work, 52 per cent passed away in circulating water, and 20 per cent in the exhaust. The consumption of gas varied from 31.13 cubic meters to 31.56 cubic meters per horse-power hour. During several hours when the machine indicated 900 horse-power and developed 700 horse-power of useful work, the consumption was 28.53 cubic meters, all of the above figures being on the basis of a gas having a thermal value of 1000 calories per cubic meter. The gas engine was of the Delamare-Debouteville type and especially designed to utilize blast-furnace gas.

Switchboards and Switches of the Modern Central Station.

IN a paper recently read before the General Electric Engineering Society at Schenectady, Mr. E. W. Rice, Jr., treated the subject of means for assuring the safety and reliability of operation of central-stations, from which we abstract the portion relating more specifically to switchboards and switches.

The moderate size of the units and the relatively low voltage employed in the older methods of central-station operation preclude any concentration of energy capable of producing extensive injury in case of a short circuit; and the sub-division of circuits, supplied in many instances by separate generators over independent switchboard and transmission lines, make it practically impossible for an accident to one generator, switchboard, etc., to affect another or all elements. Even if a serious accident or a fire should disable one station, the entire city would not be thrown in darkness or its transportation facilities crippled, because the other stations would remain intact and uninjured. These considerations seem to me obvious, and do not need further discussion.

At the present time, the numerous small stations containing moderate-sized units and differing systems, are being displaced by a single large generating station, containing a few extremely large units, usually of the alternating-current type, generating electricity at high pressures, and representing in themselves, as well as in the total output of the station, a tremendous concentration of energy in a comparatively small space. From this generating station, distribution lines or feeders are led to various sub-stations in different portions of a city, in which the reducing and converting apparatus is placed.

The consolidation and concentration just mentioned is natural; is in the direct line of the evolution of the electrical industry, and finds its parallel in all modern work. It is unquestionably proper and inevitable, and marks a distinct and desirable advance in electrical engineering. However, the concentration of such enormous energy in a small space, and its distribution at high potential with insignificant loss involve certain elements of danger which must be faced and properly solved before such a method can be considered as entirely reliable or safe. We have, in other words, practically placed all our eggs in one basket, and it is necessary that we carefully examine our basket and provide every safeguard against any accident which could smash all our eggs.

On the theory that a "chain is no stronger than its weakest link," it is necessary that every link in the chain making up a modern central station should be made as strong and reliable as possible. The design and installation of the switchboard, and the proper layout of the conducting circuits to and from the board are, if anything, of greater importance than any other feature of a central station, and yet are most frequently slighted.

It has been frequently considered satisfactory to crowd the leads from large generators in one compartment or bunch to the switchboard. The switchboard is often nothing but the ordinary panel type generally employed on relatively low-tension limited-power systems. It sometimes even contains switches which are incapable of interrupting the circuit under load or under extreme conditions. These switches are often placed so that serious arcing on one switch would easily involve other switches on the same panel, and possibly destroy or severely injure the entire switchboard. The busses carrying the current are improperly protected from other portions of the circuit. The feeders from the switchboard leading out of the station are frequently carried through one well, and crowded together in such a manner that any injury to one might easily be communicated to another, or even to all. Even in cases where the switches are so designed and insulated that they are normally capable of opening the circuits without injury and without arcing, the method just described is still highly objectionable, as it does not provide sufficient safeguard against the damage which would be likely to occur in case a switch fails to operate properly.

It is of the highest importance that the normal flow of energy in a given space should be restricted. From the generators to the bus-bars, the normal flow should naturally be limited to that of the generating unit; from the bus-bars to the distributing points, or sub-stations, it should be no greater than that of a sub-station, and if the sub-station is a larger unit than the generator, it would be better to limit the normal flow to that of the generating unit.

To illustrate, the leads from each generator to the switchboard should be carried in ducts which are separated as far as possible from those of other units, and every effort should be made to prevent the bunching or massing of these conductors in such a way that an injury to any wire or set of leads could involve those of another generator. Each set of generator leads should be connected to a suitable switch, capable of breaking not only the normal load of the generator, but also the maximum short circuit of the generating station. In order to achieve that degree of safety which such a station should possess, it is necessary to do even more; each switch should not only satisfactorily fill the conditions mentioned, but must be so located that a possible failure on its part could not destroy any other apparatus or switch. Each switch should therefore be separated from its neighboring switch, or switches, by a fireproof compartment, and also from the bus-bar in such a way that a switch could be totally destroyed without injuring anything else. If the generators are of moderate size, say 500 kilowatts or under, it would be permissible to use a switch in which all of the phases and potentials are in a suitable single compartment. However, in large-sized electrical units it would be preferable, and much safer, to so construct the switch that the different phases are in independent compartments, so that if a switch fails to open one phase, the other phases may be opened with safety. If this construction is followed in the case, say, of a three-phase generator, it would be possible for the switch in one of the phases to fail to open or arc to destruction, and yet have the circuit properly opened by the switches in the other two phases.

In the case of extremely large units, it is desirable to place two complete switches in series, each switch in its own separate compartment. This provides a condition similar to a duplicate system of steam valves and piping.

After passing the generator switches, the leads should be conducted to a bus-bar or bars, which should also be separated from all the switches either by a suitable distance or by a fireproof compartment. As the bus-bar is the only point in the station where the entire electrical energy is normally concentrated, most extraordinary pains should be taken to provide proper insulation and room for them. They should be so arranged that it will be impossible for an arc to pass from one bus-bar to another, and the connections carried to the bus-bars in such a way that no arc can pass from a switch to the bus-bar.

In large stations, Mr. Rice would therefore have the bus-bars carrying great differences of potential or a large amount of power separated by fireproof or flameproof compartments and have the bars separated from each other a sufficient distance to prevent any possibility of arcing, and so disposed that no accidental cross could be produced by the dropping of a bare wire, the loosening of a contact, etc.

From the bus-bars the conductors should be taken to feeder switches capable of opening the circuit under extreme overloads, and so arranged that an injury to one feeder switch cannot be communicated to another switch. If the feeder is of large size, carrying normally a large amount of power at high potential, the compartment method should be extended to a separation of the phases. Where, however, the normal amount of energy is small, it is permissible to place the various phases in the same switch compartment; in this case, however, the same precautions should be taken to place every switch unit in a separate fireproof compartment. The cables leading from the feeders to the sub-stations should not be bunched together in a single feeder well or compartment, but should be carried through and out of the station as widely separated as possible.

The number of such feeder wells or compartments in which feeders are grouped should preferably not be less than that of the number of

sub-stations to which the energy is transmitted. The same precautions should be taken in transmitting the energy throughout the city to the various sub-stations. The conductors should be carried down different streets, or, if in the same street, placed in compartments which are separated as far as possible from each other, to prevent any extensive injury.

Two types of switches have been found by experience to be capable of successfully and practically controlling alternating circuits of high potential, carrying large currents such as are generally employed in the large stations which we have discussed.

First, an air switch, which is nothing but a greatly enlarged switch of the usual type, the poles being separated a sufficient distance apart, and the break being large enough to insure interruption of the circuit. There switches are open to the serious objection that when several generators supply current through a number of feeders, the room required to properly control circuits of 5000 or 10,000 volts is so great that it cannot be easily provided for such switches. The arcs also destroy the contact surfaces in time, and in general, high-potential arcs producing large quantities of vapor are not desirable in a central station.

The second type is the oil switch, in which the terminals are separated under a bath of oil. Many modifications of this switch have been proposed and used. These switches seem to be capable of breaking successfully and continuously almost any amount of energy within the limits employed in practice. These switches have an advantage over the air type, in that the circuit is interrupted after an extremely small separation of the switch parts under oil, and no arc is produced outside of the switch. The switch is therefore essentially compact. It is open to the objection of increased fire risk, due to the oil. This fire risk must be considered and minimized by the proper design of the switch, which is easily accomplished by a sub-division of the switch into compartments as proposed.

In central stations where generators are wound for a comparatively low pressure, step-up transformers to increase the pressure to that of the transmission lines are generally employed. These transformers may be of two general types. First, transformers without oil, cooled by an air current, generally known as air-blast transformers. Second, oil-immersed transformers, in which oil is relied upon as the insulating and cooling medium. A vigorous circulation takes place in the interior of such transformers, conducting the heat from the interior to the external case, or, in large-sized transformers, the oil is cooled by the circulation of water through coiled pipes immersed in oil. Air-blast transformers containing the same methods of insulation as the generators, are as free from risk of fire as the generators, and if placed moderate distances apart, are not subject to accidents which may be communicated from one to another, or otherwise endanger the station. They may therefore be placed in the same room with the switchboard or with the generators. Oil-immersed transformers containing large quantities of oil are a fire risk which must be recognized and carefully treated, or they may endanger the switchboard, station and other apparatus, and their general use become discredited. Such oil transformers should be placed in a separate fireproof room or building from that of the generators or the switchboard. The transformer house in this instance is just as important as the boiler house for the generation of steam. It would be indeed preferable, in the case of extremely large units, to sub-divide the transformer house, for reasons already stated. It would be further advisable to connect the oil tanks with the sewer, so that in case the oil should take fire from any cause, it could be drained away so as to limit the amount of combustible material.

The objections which have been urged against the methods above suggested are, briefly, the increased cost of the switchboard and the additional space occupied. However, the cost of a switchboard, etc., even if the methods suggested are fully carried out, will usually be relatively small compared with the total investment in a large generating station; the room occupied is also a small proportion of the total space required. The additional cost and the room occupied are therefore insignificant compared with the small saving possible by a more concentrated and relatively unsafe method. If the facts are properly presented to the engineer or manager responsible for such a modern station, the small difference in room or expense should and probably would be considered as of small importance. The additional expense is a cheap insurance against the possibility of a serious or general shut-down.

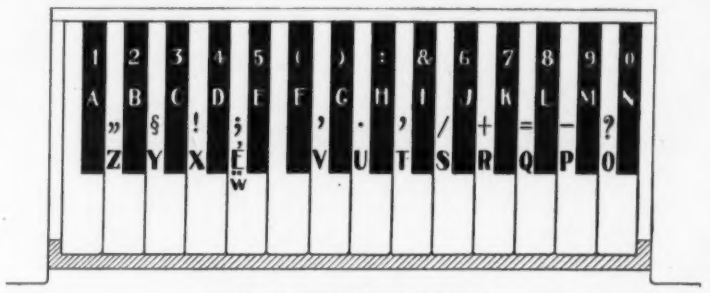
It may be claimed that the dangers which may result from the present tendency to apply the same general methods of installing and operation of the switchboards, transformers, etc., used in a small station, to a large station, are overestimated. This is a matter of judgment. When one considers the enormous amount of energy available in a modern power station, rising in many instances to 25,000 and occasionally to 50,000 or more horse-power, and considers also that this energy is usually generated, controlled and transmitted at pressures ranging from 5000 to 10,000 or more volts, and is transmitted over conductors which have practically no loss compared with the older transmission systems, it would seem that we have reason to fear the destructive effects of the concentration of this energy upon one spot, as in a short circuit.

It is quite possible that the flow of energy which a switch may be called upon to interrupt, in such a case, may prove too great for even the best-designed switch, and destructive arcing result; in which instance, unless the switchboard system is so designed that such an accident could occur without involving other switches or portions of the switchboard, serious and extensive breakdown may occur.

It must not be forgotten that the disturbance created by the disablement of such a large station is in proportion to its magnitude. When one also considers the heavy losses which might result to the stockholders of a company, and the inconvenience and burden to the public by the breakdown of such a station for even a short time, it is better to err on the side of conservatism, and stick to the motto that "An ounce of prevention is worth a pound of cure."

Proposed Modification of the Keyboard of the Hughes Telegraph Transmitter.

A modification has been proposed by M. Paul Faurt, of Algiers, Africa, of the keyboard of the Hughes telegraph transmitter, consisting in a division and separation of the second half of the keys; the main object of this modification being the practical one of rendering the keyboard more easy of manipulation. In the present keyboard, the numbers from one to nine and zero follow consecutively on the black keys, starting from the left. The inconvenience of this disposition has made itself evident to all who have worked with the



PLAN OF MODIFIED KEYBOARD.

Hughes apparatus. To obviate it, Monsieur Faurt simply separates on the keyboard the first five figures from the last five by four signals ordinarily but little used. This modification not only results, it is stated, in increasing considerably the speed by permitting a higher number of combinations (principally in financial, commercial and code telegrams), but it also renders the manipulation of the keyboard more convenient and easy, with the consequence of requiring less time to learn to use the transmitter. The accompanying diagram illustrates the proposed modification.

American Association for the Advancement of Science.

The council has elected nearly 250 new members since the last meeting, most of these having been elected at the meeting last Saturday.

Among the new members who are well known either in scientific, social or political circles, are James Douglas, to whom George Iles dedicated his recent book, "Flame, Electricity and the Camera;" Abram S. Hewitt, Cornelius N. Bliss, Thomas C. Platt, Walter S. Logan, president of the New York Bar Association; George M. Olcott, George A. Peabody, Edward Cooper, President Jacob G. Schurman, of Cornell; Professors E. B. Wilson and John D. Quackenbos, of Columbia; James S. Benedict, John S. Eno, Dr. R. N. Sayre, Henry V. Parsell, Jr., Mrs. Henry Draper, Mrs. E. L. Godkin, Misses C. Phelps Stokes and O. E. P. Stokes.

Copper Saving in the Joint Transmission of Direct and Alternating Currents.*

By Frederick Bedell.

If an alternating and a direct current be superposed, the virtual value of the resultant is the square root of the sum of the squares of the direct and alternating currents. It follows that the joint transmission of direct and alternating currents results in a saving in weight of copper and in copper losses, and it will be shown in the tables which follow that *either saving may be as much as 50 per cent.*

The question of systems of distribution for the joint transmission of direct and alternating currents is here considered merely in the one aspect of copper saving. It may be said that no engineering obstacles arise to detract from the practicability and desirability of such a system. The requirement is a system of line distribution whereby independent alternating-current and direct-current generators may supply current to independent alternating-current and direct-current apparatus, the alternating and direct currents being independent in their generation and utilization, and combined in their transmission. In the following discussion are designated the two currents as I and i, these being called the first current and second current, respectively. A single length of conductor is taken as the basis of discussion.

Table I. shows the relative heating effects of like and unlike currents. Table II. shows the saving in the joint transmission of direct and alternating currents on the basis of the same current density in their joint transmission as in their independent transmission. Table III. shows the saving in the copper when total losses are the same for joint as for independent transmission. Table IV. shows saving in losses would depend upon the *square of their sum*... When one curcarding entirely the copper of one of two systems, and retaining only the copper of the remaining system to carry both currents.

TABLE I.

RELATIVE HEATING EFFECTS OF LIKE AND UNLIKE CURRENTS.

I, First current.	i, Second current.	$I+i$, Sum.	I', Resultant, unlike currents.	Heating effect, like currents.	Heating effect, unlike currents.
1	.1	1.1	1.005	1.21	1.01
1	.2	1.2	1.020	1.44	1.04
1	.3	1.3	1.044	1.69	1.09
1	.4	1.4	1.077	1.96	1.16
1	.5	1.5	1.118	2.25	1.25
1	.6	1.6	1.166	2.56	1.36
1	.7	1.7	1.221	2.89	1.49
1	.8	1.8	1.281	3.24	1.64
1	.9	1.9	1.345	3.61	1.81
1	1.0	2.0	1.414	4.00	2.00

Discussion of Table I.—The fourth column in this table gives the virtual value of the resultant current I' obtained from the joint transmission of the currents I and i, either one of these being alternating and the other direct. It will be seen that the resultant current is always considerably less than the algebraic sum of the two component currents, and that, in fact, it is only slightly larger than the value of the first current, column 1.

This saving in the resultant current assumes importance from the fact that the line losses vary as the square of the current. If the two currents I and i were like currents (*i. e.*, both being direct currents, or both alternating currents of the same phase and frequency) the losses would depend upon the *square of their sum.* When one current is alternating and the other direct, the losses depend upon the *sum of their squares.* For like currents, I and i flowing through a resistance R, the losses are:

$$RI^2 + 2RiI + Ri^2.$$

For unlike currents, the losses are only

$$RI^2 + Ri^2.$$

These are tabulated in the last two columns of Table I., from a comparison of which the saving in using unlike currents is obvious. For example, let us suppose we have a line carrying one ampere of current. If we increase this by the addition of one ampere of like current, the losses will be 4; whereas, if we add one ampere of unlike current, the losses will be only 2. Now, every current of two amperes may be considered as made up of two like currents of one ampere each. If one of these could be replaced by an unlike current, the losses would be reduced in the ratio of 4:2. As has been shown above, when we combine an alternating and a direct current, the losses are $RI^2 + Ri^2$; that is, the losses are the sum of what the losses would be separately. *This means that each current acts as though it had the whole conductor to itself and the other current were absent.* Accordingly, the conductors of an alternating-current system may be used also as the conductors for a direct current, exactly as if the alternating current did not exist, and vice versa. The losses are figured independently, being RI^2 and Ri^2. Inasmuch as line losses and line drop are proportional, *we may figure the line drop for the alternating current as though the direct current did not exist, and figure the drop for the direct current as though the alternating current did not exist.* The line drops for the two currents are RI and Ri.

TABLE II.

SHOWING THE SAVING IN DISTRIBUTING DIRECT AND ALTERNATING CURRENTS JOINTLY INSTEAD OF SEPARATELY, ON THE BASIS OF CONSTANT CURRENT DENSITY.

I, First current.	i, Second current.	Saving in total copper, %.	Saving in total line losses, %.	Saving in drop for I, %	Saving in drop for i, %
1	.1	8.64	8.64	.50	90.05
1	.2	15.00	15.00	1.96	80.40
1	.3	19.69	19.69	4.21	71.27
1	.4	23.07	23.07	7.15	62.86
1	.5	25.47	25.47	10.55	55.27
1	.6	27.12	27.12	14.24	48.54
1	.7	28.18	28.18	18.10	42.67
1	.8	28.83	28.83	21.94	37.55
1	.9	29.21	29.21	25.65	33.09
1	1.0	29.30	29.30	20.30	29.30

Why unlike currents do not interfere.—That two unlike currents in nowise interfere may perhaps be appreciated from the following example: Suppose we have a direct current of 10 amperes and add thereto an additional ampere of like (direct) current. The whole current is now 11 amperes, which flows with uniform density in the conductor, so that the original current of 10 amperes has only 10-11 of the conductor for its use. An additional current of like kind, therefore, interferes with the original current. Let us now suppose that with an original direct current of 10 amperes, we have an added ampere of alternating current. Half the time this is of the same polarity as the direct current, and increases the current density in the conductor; but half the time the alternating current is opposite in polarity to the direct current, and during this time makes the total flow of current less and the current density less than for the direct current alone. In other words, the additional ampere of direct current interferes all the time with the original direct current; whereas the additional ampere of alternating current acts as a detriment for half the time, and as an assistance for half the time, these two effects tending to cancel.

TABLE III.

SHOWING SAVING IN COPPER AND CHANGE IN LINE DROP FOR JOINT TRANSMISSION WITH THE SAME TOTAL LOSSES AS IN SEPARATE TRANSMISSION.

I, First current.	i, Second current.	Saving in total copper, %.	Increase in drop for I, %.	Saving in drop for i, %.
1	.1	16.5	9.0	89.1
1	.2	27.8	15.4	76.9
1	.3	35.4	19.2	64.2
1	.4	40.9	20.7	51.7
1	.5	44.3	20.0	40.0
1	.6	46.9	17.6	29.4
1	.7	48.4	14.1	20.1
1	.8	49.3	9.8	12.2
1	.9	49.9	5.0	5.6
1	1.0	50.0	0.0	0.0

Discussion of Tables II., III., IV. and V.—These tables show the saving in joint over separate transmissions under different conditions. On the basis of a given current density, Table II., there is a saving

*Abstract of a paper read at the New York Meeting of the American Association for the Advancement of Science, June 26-30, 1900.

both in copper and in losses, which may amount to 29 per cent in each simultaneously. In Table III., the saving is in copper alone, and in Table IV., in losses alone, running up to 50 per cent in each case. Table V. shows the saving under very practical conditions—that is, one system is in nowise changed. This is the case where we already have an existing system installed and superpose a second current.

In designing a new composite system, a good rule to follow is to figure the conductors first for each system of conductors independently, and install the larger conductor only. The saving will then be as in Table V. Nothing is sacrificed and there is a decided gain.

TABLE IV.

SAVING IN CHANGING FROM SEPARATE TO JOINT TRANSMISSION, ON THE BASIS OF THE SAME AMOUNT OF TOTAL COPPER.

I, First current.	*i*, Second current.	Saving in total loss, %.	Saving in drop for *I*, %.	Saving in drop for *i*, %.
1	.1	16.5	9.1	90.9
1	.2	27.8	16.7	83.3
1	.3	35.4	23.1	76.9
1	.4	40.9	28.6	71.4
1	.5	44.3	33.3	66.7
1	.6	46.9	37.5	62.5
1	.7	48.4	41.2	58.8
1	.8	49.3	44.4	55.5
1	.9	49.9	47.4	52.6
1	1.0	50.0	50.0	50.0

Extension of Profitable Radius of Distribution.—Inasmuch as direct current can be transmitted on the whole more economically jointly with alternating current than separately, it follows that the radius of economic transmission of direct currents can be thus extended. We may draw a circle inside of which it is already profitable to transmit direct current by the usual independent system. In this circle, the advantage obtained from the joint transmission of direct and alternating currents comes from the greater profit on account of the saving already pointed out.

We may draw a second larger circle within which it is profitable to transmit alternating and direct currents jointly for general purposes.

TABLE V.

SHOWING THE SAVING WHEN, OF TWO SYSTEMS CARRYING CURRENTS *I* AND *i*, AT THE SAME CURRENT DENSITY, THE LATTER SYSTEM IS ABANDONED AND THE FORMER SYSTEM (UNCHANGED) CARRIES BOTH CURRENTS.

I, First current.	*i*, Second current.	First (*I*) system.	Second (*i*) system, copper saved, %.	Second (*i*) system, saving in line losses and drop, %.	Saving in total losses, %.	Saving in total copper, %.
1	.1	Nothing	—100 % saved.—	90	8.27	9.1
1	.2	altered.		80	13.30	16.7
1	.3	Line		70	16.16	23.1
1	.4	drop		60	17.15	28.6
1	.5	and		50	16.67	33.3
1	.6	losses,		40	15.03	37.5
1	.7	weight		30	12.30	41.2
1	.8	copper		20	8.83	44.4
1	.9	as		10	4.80	47.4
1	1.0	before.		0	0.	50.0

Outside the first circle and within the second, the advantage in the joint transmission, arises from the extension of the profitable territory covered. It is not possible to lay down any general rule for determining the size of those two circles, local conditions being controlling elements.

Beyond the second circle it is not profitable to transmit direct current, even in conjunction with alternating, for general purposes. However, direct current may then be transmitted to advantage, over alternating lines for special purposes, among the most important of which may be placed the starting of rotary converters, supplying magnetizing current for synchronous motors, and the like. For these special purposes, the gain is not so much in the efficiency as it is in the increased engineering possibilities, the discussion of which is beyond the scope of this paper.

The Convention of Railway Telegraph Superintendents.

The nineteenth annual convention of the Association of Railway Telegraph Superintendents, held at the Wayne Hotel, Detroit, Mich., on June 20, 21, 22, was the most successful of the long series of meetings so far held, whether considered in numbers present, interest shown or work accomplished. All of the leading railroads sent delegates, and the proceedings were marked throughout with a dignity and earnestness of purpose, not unmixed with enthusiasm, that well reflected the animating spirit of the occasion.

A significant feature of the convention was the very full utterance given to the claims of the telephone as an operating factor in railroad service. It was argued that while, perhaps, the telephone is not destined to supplant the long-used telegraph in this respect, yet in many ways, it must in the future be accepted at least as a close and important auxiliary thereto.

Mr. L. B. Foley, the president of the association, called the meeting to order at 10 o'clock Wednesday morning, June 20. He stated that in the absence of Mayor Maybury, the city of Detroit would be represented by Mr. W. H. Hall, private secretary of the mayor, who was then introduced. Mr. Hall spoke briefly, and in most fitting terms welcomed the delegates to the city. To the cordial words spoken, President Foley aptly responded in behalf of the association. The meeting was then declared open for business, and Mr. P. W. Drew, the secretary and treasurer, was called upon to read his report. This showed a good cash balance on hand to the credit of the association. Following this came the election of new members, six being elected.

The other features of the morning session were the reading of papers by Mr. Charles Selden, of the Baltimore & Ohio Railroad, Baltimore, Md.; Mr. Charles F. Annett, of the Illinois Central Railroad, and by Mr. Henry W. Pope, the general manager of the Bell Telephone Company, of Buffalo, N. Y. The general theme of these contributions was the use of the telephone by the railroads as an auxiliary to the telegraph as an operating factor, a subject now attracting wide attention, and the presentation of which was closely followed. Mr. Selden considered the telephone as an adjunct of the telegraph in handling railroad business; Mr. Annett explained at length the development of the telephone system on his road, while the title of Mr. Pope's paper was the "Railway and the Telephone."

The afternoon session met at 2 o'clock. A resolution was adopted expressive of the sorrow felt by the association in the death of William J. Holmes, late superintendent of telegraph of the Erie Railroad, New York. This was ordered spread upon the minutes, and a copy to be sent to the family of Mr. Holmes.

An amendment to Article 3 of the constitution was adopted, as follows: "Any one connected in official capacity with the telegraph, telephone, signal, electric light or power departments upon a railroad, may become a member of this association upon a majority vote of a quorum present, by subscribing to the constitution and paying into the treasury the sum of five dollars per annum."

A further discussion of the telephone in its relation to the railroads was continued during the afternoon, showing the interest the question had in the minds of the members. Mr. J. H. Jacoby, of the Lehigh Valley Railroad, South Bethlehem, Pa., while acknowledging the value of the telephone to the railroads, in conjunction with the telegraph, did not think that it would ever supersede the latter in its employment as an operating factor. Nevertheless, he advocated the education of employees in the proper use of the telephone, and as a means to an end suggested the posting of a full set of rules adjacent to each set of instruments convenient for guidance and for study. Mr. A. A. Robinson, of the Central Union Telephone Company, Chicago, gave an outline of what his company was willing to do to meet the demands of the railroad companies.

Mr. George L. Lang, of Lexington, Ky., read a paper entitled "Reminiscences of an Old-Time Telegrapher," written by Mr. Joseph B. Tree, superintendent of telegraph of the Western Union Telegraph Company, Richmond, Va.

At 9:30 a. m., on June 21, the second day's session was called to order. The first business was the election of officers. The result of the ballot showed that Vice-President W. F. Williams, superintendent of telegraph of the Seaboard Air Line, Portsmouth, Va., was elected to the presidency; C. F. Annett, of the Illinois Central, Chicago, vice-president, and P. W. Drew, of the Wisconsin Central Railroad, Milwaukee, was continued in the position of secretary and treasurer he has so long and faithfully filled.

For the next place of meeting, the committee on time and place

reported in favor of Boston, Mass., and named June 19, 1901, as the date, a report that was unanimously adopted. The selection of a committee of arrangements followed, and Messrs. E. A. Smith and F. H. Valentine, of Boston, and L. S. Wells, of New York, were chosen.

Then came the reading of a paper entitled "The Electrical Accumulator or Storage Battery for Telegraph Use," by Mr. J. H. Jacoby, of the Lehigh Valley Railroad, South Bethlehem, Pa.

The paper was discussed by G. L. Lang, of Lexington, Ky.; C. A. Darlton, of Washington, D. C.; Charles Selden, of Baltimore; I. N. Miller, of Cincinnati, and William Maver, Jr., of New York.

Mr. H. T. Simpson, of the Chesapeake & Ohio Railroad, Richmond, Va., read a paper on "Railroad Block Signals."

The discussion over the paper was participated in by C. A. Darlton, of Washington, D. C.; W. C. Walstrum, of Roanoke, Va.; G. C. Kinsman, of Decatur, Ill., and C. S. Rhoades, of Indianapolis, Ind.; G. L. Lang, of Lexington, Ky., and J. H. Jacoby, of South Bethlehem, Pa.

The next paper read was on "Automatic Crossing Alarms," by J. S. Evans, of the Nickel Plate, Cleveland, Ohio.

Mr. Evans gave figures to show that the protection of highway crossings with gate and gateman required an initial investment of $300, and thereafter a maintenance expense of $400 per year. On the other hand, to guard a crossing with an automatic alarm means approximately an initial investment of $200 and a maintenance expense of $50 per year. The closed-track automatic alarm circuit has been universally adopted on account of its simplicity, reliability and automatic tell-tale qualities, if properly constructed. A crossing signal should be designed to meet the following requirements: The alarm at the crossing should be given when the first pair of trucks reach a point sufficiently distant from the crossing to give at least twenty seconds warning for the fastest approaching train, and it should not cease until the last pair of approaching trucks has crossed the highway. The system should be such that if the batteries become exhausted either from actual work or accident, an indication thereof shall be given. The breaking of relays, wires or other mechanism forming a part of the highway alarm should also be automatically indicated.

This paper brought out a discussion by U. J. Fry, of Milwaukee; Charles Selden, of Baltimore, and C. S. Rhoades, of Indianapolis.

The third day's session, which was confined to the morning hours only, was called to order at 9:30 on June 23, President Williams in the chair. The appointment of the committee on topics for the ensuing year was then made, Messrs. J. H. Jacoby, C. A. Darlton and U. J. Fry being named.

Following this, Mr. William Maver, Jr., of New York, read a paper entitled "The Electrical Condenser and Some of Its Uses in Telegraphy."

Mr. Maver's paper was discussed at length by Messrs. J. H. Jacoby, of South Bethlehem, Pa., and I. N. Miller, of Cincinnati.

Mr. W. W. Ryder, of Chicago, discussed the question of low resistance relays, which are now giving such general satisfaction on the various railroads of the country.

Suggestions to operators handling switchboards was the subject next brought to the attention of the members by Mr. George C. Kinsman, of Decatur, Ill.

The committee on courtesies presented a resolution thanking the several local committees for their kindness and efforts to promote the success of the convention and to provide for the welfare of the members. Especially was appreciation expressed for the work so successfully accomplished by Messrs. E. E. Torrey and J. W. Fortune, of Detroit; J. S. Evans, of Cleveland, and G. S. Kinsman, of Decatur, Ill., constituting the committee of arrangements, and who were indefatigable in their efforts to make every one comfortable.

An earnest recommendation was made by Mr. Charles Selden, of Baltimore, Md., that a censorship of railroad messages might be had, in order to reduce the amount of unnecessary railroad telegraphing, now the subject of well-nigh universal complaint. Mr. G. C. Kinsman, of Decatur, Ill., in further referring to the matter, stated that, in his judgment, the improvement of the railroad mail service would tend to overcome the trouble cited.

Mr. George M. Dugan, of Chicago, Ill., explained his system of underground cables for track crossings, as employed along the Illinois Central Railroad. It was an interesting statement, and no trouble, it was said, had been experienced in their operation, although some of the cables had been in use for five years. The convention adjourned at 12:15 o'clock.

Pupin Telephone Line Patents.

Two patents were issued to Prof. M. I. Pupin, June 19, relating to the method of improvement of telephonic transmission which formed the subject of a recent paper read before the American Institute of Electrical Engineers.

In one patent the claims are on a method of diminishing the attenuation constant of a uniform wave conductor, which consists in sufficiently increasing the inductance of the conductor by distributing along its inductances at periodically recurring points; the distance between consecutive points being such as to preserve approximately the character of the line as a uniform conductor with respect to the waves to be transmitted. As will be seen, the above is a method patent, and the second patent relates to details for putting it into effect. One claim specifies that the distance between the interposed coils shall be adjusted in such a way as to equal a fractional part of one-half of the shortest wave length which is to be transmitted; another claim specifies that the distance between the interposed coils shall be adjusted in such a way as to be equal to the fractional part of one-half of the wave length corresponding to the highest frequency essential to the transmission of speech. Two other claims specify that the distance between consecutive inductance coils shall be equal to or less than one-sixteenth of the smallest wave length which is to be transmitted, or to one-sixteenth of the electrical wave length corresponding to any frequency which is essential to the transmission of speech.

The method is illustrated with reference to two particular cases. One of these is for a telephone line 3000 miles long, consisting of a copper wire of 4 ohms per mile resistance, the capacity per mile of such wire hung as are the long distance air lines of the American Bell is .01 microfarad. To secure a sufficiently high degree of approximation to a uniform telephone line, one coil per mile is required, the inductance of which should be .2 henry and the resistance .6 ohm. Such a coil, using no iron, would take about 16000 feet of wire, of 2 ohms per mile wound into a coil of 5 inches internal diameter and 12 inches in length. This line would be of comparatively high inductance, and transmitter coils of a larger transformation ratio than those employed at present will be found more suitable for working over such a line.

The other case is that of a submarine cable 2000 miles long. According to present cable construction, the capacity per mile would be .3 microfarad, and it would be necessary to introduce 8 coils per mile, having an aggregate inductance of .3 henry, and a resistance of 1 ohm per mile, thus increasing the ohmic resistance to 6 ohms per mile. Employing cores of iron or steel, it is stated that coils of this inductance can be readily made which will be small enough to go within the sheathing of a submarine cable, as these are constructed to-day, and at the same time show negligibly small Foucault-current and hysteresis losses. The construction of the coil is described in detail, it having a diameter when finished less than 2.5 inches and a length of 4.25 inches. It is added that unless induction coils with iron cores are constructed in such a way as to keep down the magnetization, hysteresis, Foucault losses and distortion of the current by the varying value of the magnetic permeability of each cycle of magnetization, they will work disastrously.

CURRENT NEWS AND NOTES.

ENCLOSED LAMPS ON CIRCUITS OF UNITED ELECTRIC LIGHT AND POWER COMPANY OF NEW YORK.—In the article which appeared last week, on the United Electric Light and Power system of New York City, it was erroneously stated that the enclosed arc lamps burned for 50 hours without trimming. The statement should have been that they burn 100 hours without trimming, the lamps being of the Standard Manhattan 100-hour type.

LONG-DISTANCE TRANSMISSION IN ST. PAUL.—The St. Paul Edison Electric Light & Power Company expects to have a part of its long-distance transmitting plant in operation by Aug. 1. The power-house at Apple River is completed, and also the 25,000-volt overhead line to the city limits. The three miles of underground cables are nearly completed. These are probably the highest voltage underground cables yet installed. One is rubber insulated and made by the Safety Insulated Wire Cable Company of New York, and the other is of oiled-paper insulation, made by the National Conduit and Cable Company of New York. All six of the 375-kw, 6-phase rotaries will probably be in operation by Sept. 15, and the city of St. Paul supplied with light and power from the Apple River power-house, 25 miles distant.

ELECTRIC RAILWAY DISTRIBUTION.—A patent issued June 19 to Sigvald Krohn, of Berlin, Germany, provides, in the case of a grounded return electric railway system, for the reduction of the differences of potential at the different points of the return circuit by means of counter e. m. f. devices interposed between the station end of the rail branch and the generator, in connection with an auxiliary feeder connected from the ground side of the generator to a rail branch at a point or points distant from the station where the difference of potential may be sufficiently greater than that at the station end to cause trouble from electrolysis, etc. In one case shown the generator of counter e. m. f. is driven by a station booster, the auxiliary counter e. m. f. conductor being connected at approximately the same position on the line as the booster feeder.

RAILWAYS IN THE AZORES.—The consul at St. Michaels writes that the time for acceptance of bids for a railway in the Azores has expired, and no proposition was received. He learns that a citizen of St. Michael, who claims to be backed by English capital, has offered to build and maintain a steam or electric railway over the proposed route; the concession being for 99 years, with an option to the government to purchase at the end of 35 years in return for 6 per cent. dividend on the cost of equipping and building the road for the remainder of the period of concession. It is stated that the colonial authorities consider this proposition favorably, but as some time will elapse before action will be taken, the consul suggests that an American company might make a proposition. He considers that an electric railway in the Azores would be a good investment.

Photometric Value of Arc Lamps.

To the Editors of Electrical World and Engineer:

Sirs:—In the editorial comments in your issue of June 2, on my report to the National Electric Light Association Committee on "The Photometric Value of Arc Lamps," there are some statements of a misleading character, due, I think, to an erroneous interpretation of certain parts of the report.

First, as to the use of the rotating sectored disk in the manner described, I said that the ratio of the light transmitted to the light cut off does not *appear* to be the ratio of the open to the closed arc. After questioning this statement you proceed to say the same thing in substance. Probably the word "appear" has been interpreted in too general a sense. No one avers that the radiant energy is not cut down in the ratio named, but the physiological effect of this energy should be cut down in the same ratio; that is to say, that the sensation should be changed proportionately to the stimulus. This is the question that I intended to raise, and this is the question investigated by Ferry.

Second, as to the units employed, I quote in the same editorial, "the results are expressed in a new and curious unit of light flux, namely, the flux throug 4π steradians concentric to a standard Hefner-Alteneck lamp as a point source." This is quite wrong. The results are in Hefner units, pure and simple, or what may be called *candle power*. I have scruples, however, against using the term candle power in connection with results obtained by methods that did not, I am happy to say, involve the candle. Were the results in terms of *luminous flux*, the numerie representing them would be much larger. Thus, a mean spherical intensity of *I* Hefner units means a total luminous flux of 4π I lumens. I used the term "flux" repeatedly in the report, because I think the conception is an excellent one, scientifically based and very useful when it is a question of computing mean illumination, as Blondel has clearly pointed out in his articles on a proposed system of light units.

St. Ignace, Mich. C. P. MATTHEWS.

[In our editorial columns for the 2d of June, pp. 810-811, we had no desire to comment unfavorably upon the excellent report read before the National Electric Light Association; in fact, we have nothing but praise for this extensive research. As regards the first point, concerning the Ferry effect, we criticized the form of the statement as likely to be misinterpreted, and we seem to be entirely in accord with Prof. Matthews as to the facts. As regards the second point raised—namely, the unit of light—we think that Prof. Matthews misunderstands our editorial statement. We refer to page 37 of his printed report, and to the passage thereon: "Hence the power required to produce one unit of light in this type of lamp is: . . ." This unit of light cannot be candle-power, because candle-power is not light, but is light divided by solid angle. The unit quantity of light in which the numerical results are given in the report is such a quantity as streams from a Hefner-Alteneck lamp as point source through 4π steradians, and a Hefner lamp emits unit light flux on this hypothesis. Prof. Matthews seems to think that we refer to the unit on the basis of a Hefner lumen or that flowing through a single steradian, in which case, as he justly remarks, the numerical equivalents would all have to be 4π times larger; but as we purposely chose a flux unit 4π times larger in which to state the results, the numerics which he states in the report do not have to be enlarged, but refer equally to mean spherical Hefners or to luminous fluxes in terms of a unit of flux equal to that through 4π steradians coming from a Hefner point source. We, therefore, regard as correct our original statement to which Prof. Matthews takes exception.—EDS.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Temporarily Conducted by E. F. ROEBER, Ph. D.

DYNAMOS, MOTORS AND TRANSFORMERS.

Transformer for Medical Purposes.—RENAUD.—An illustrated description of a simple, alternating-current transformer for surgeons. Upon a ring-formed, iron core the primary turns are wound. There are two secondary circuits, wound around the primaries; the wires of the two secondary circuits are of different thickness and each secondary circuit covers one-half of the ring. The number of the secondary turns used can be adjusted, as the current is taken off by means of two sliding contacts. Both secondary circuits are used at the same time for supplying current to a surgeon's instrument, and to a small lamp for medical examination, etc.—*L'Elec.*, June 9.

Automobile Motors.—FIELD.—An illustrated description of two new automobile motors. In the one, devised by Egger, Vienna, all gears and pinions have been discarded; the motor is of the multipolar, slow-speed type; the armature is mounted on the extended portion of the hub of the wheel, and revolves with it; the commutator has been placed within the circle of the armature, so that the width of the motor is only that of the armature windings; the axle is stationary, and the frame supporting the fields is fastened to it and the frame of the running gear. The second type of motor is built by the Hub Motor Company, of Chicago; the vehicle wheels possess specially constructed hubs, to the inner surface of which the fields of the motor are attached; the fields turn with the wheel; the hub casing bears on its inner surface a gear into which meshes an intermediate gear turning on a stud fixed to the axle, which is stationary; the armature is mounted on a hollow shaft or quill, and drives the hub through the intermediate gear by a pinion on the extremity of its shaft; the armature, as well as the field, are free to turn, and thus the relative speed between them may be high; the current is conveyed by means of sliding contacts, and the wires are carried to them through grooves in the stationary axle; the motor is fitted with ball-bearing throughout. The general design of the motors is given in two diagrams.—*The Automobile*, June.

POWER.

Refuse Destructors.—The conclusion of the article, noticed in the Digest, June 23. The heat produced by the burning of the refuse can be utilized, but only for some purpose which does not depend for its efficiency or economy upon a more or less constant heat supply; up to the present it is said the only really satisfactory use was in grinding up the clinker from the furnace for manufacture into concrete paving blocks or mortar. A paper of Healy on the economic disposal of town refuse is abstracted. Finally, it is said that a record of results, extending over a period of not less than one year, would yield the

only reliable data upon which to base an estimate of the value of the incinerator as a means of destroying refuse or of raising steam.—Lond. *Elec. Rev.*, June 8.

REFERENCES.

Electricity in a Dockyard.—A brief note stating that steam power is now to be superseded by electric power to a very considerable extent in the government dockyard at Kiel, Germany. The whole of the machine tools installed in the different workshops, and the powerful dockyard pumps are also to be electrically driven. The power plant will have a capacity of 3500 horse-power.—Lond. *Elec. Eng.*, June 8.

Japanese Workshop.—A brief, illustrated description of the Shibaura Engineering Company, which is the largest company manufacturing electrical machinery in Japan. The workshop plant, machine tools, etc., are all American, and of the most modern type, and are driven throughout by three-phase motors on every shaft, the current being supplied from a 600-hp, three-phase generator of the General Electric Company, of this country.—*Lightning*, June 7.

Manufacturing Plant.—A well-illustrated description of the works of the Bullock Elec. Man. Company. Every machine tool throughout the works has its individual electric motor, and, in most instances, the motor is direct-connected to the machine, belts being omitted wherever possible.—*Amer. Mach.*, June 14.

Electrical Supply by Gas Companies.—Adams.—An article advocating that a gas plant, ready to deliver a larger supply of gas in a wide and thickly settled area, should operate in that area a number of gas-driven electric stations. Electric energy from such small stations can be sold for several times the price of the gas consumed in its operation; besides, there are conditions which make it possible to generate electric energy at such stations at a less sum per unit than with most other systems. He gives estimates of the cost of installation and operation.—*Sc. Amer.*, June 16.

Blast Furnace Gas.—An illustrated description of recently made trials of a 600-hp blowing engine worked by blast furnace gas.—Lond. *Elec. Rev.*, June 8.

Power Distribution in Agricultural Districts.—A note stating that an association of farmers in Bavaria is building an electrical plant near Schaftersheim, the prime motive power being partly steam and partly water power. The current is to be transmitted at 5000 volts to the surrounding villages, where it will be used for driving various agricultural machines. No further technical information is given.—*Feilden's Mag.*; Lond. *Elec. Eng.*, June 8.

TRACTION.

Three-phase Traction.—Reichel.—A very long, illustrated article. He refers to early experiments of Siemens & Halske with three-phase motors for traction (*Elec. World*, 1893, vol. 12, p. 164), and shows the advantages of the continuous-current series motor over the three-phase motor for ordinary tramway lines in cities; the speed regulation is easier with the direct-current motor; for a line which is partially level and partially has grades, the three-phase motor must be heavier than the continuous-current motor, which is shown in a numerical example; the arrangement of the feeders is simpler with a continuous-current than with a three-phase system. He says that, although it cannot be said that in all cases the continuous-current system must be cheaper for tramway lines in cities than the three-phase system, the cost depending very much upon the local conditions; nevertheless an exact calculation of many practical examples has shown that this is correct in most cases, because the special features of the three-phase motor cannot be used there to advantage. Much more favorable to three-phase systems are the conditions of interurban railways and trunk railways, where there is not such a variation of the power consumption as on tramways with their frequent stops, nor generally such a variation of the torque as on lines which are partially level and partially inclined. If there are heavier grades, as in mountain railways, they cover a greater distance, so that the motors are to be designed in accordance with them; when running down, the three-phase motors give a part of the current back to the line. He assumes that the highest voltage which is at present feasible for continuous-current traction motors is 1000, and the highest voltage for three-phase traction motors is 4000, and says that therefore the following five systems are possible in electric traction: (1) continuous current, at 1000 volts or below, is generated in a number of power houses along the line, to be supplied to the motors on the cars without transformation; (2) high-tension, polyphase current is transmitted to a number of sub-stations along the line, where it is converted into continuous current, at 1000 volts or below, to be supplied to the motors on the cars; (3) high-tension, three-phase current is transmitted to a number of transformers along the line, where it is transformed to three-phase current at 1000 volts or below, to be supplied to the three-phase motors on the cars; (4) three-phase current, at 1000 to 4000 volts, is fed to the line, to be supplied direct to the three-phase motors on the cars; (5) three-phase current, at 4000 to 15,000 volts or more, is fed into the line, to be supplied to transformers on the cars, where it is transformed down and supplied to the motors. He considers the case of an electric trunk railway of about 150 miles, and shows that with the second system two power houses and eight sub-stations would be necessary, while with the fifth system one power house is sufficient. The fifth system is, therefore, especially adapted for trunk railways. He describes a series of experiments, made by Siemens & Halske with such a system on an experimental line, near Berlin. The arrangement of the trials is described in detail. The current was supplied to the cars by three overhead trolley wires. A system of safety wires was required below the trolley wires, in order to prevent an accident in case a trolley wire should break; therefore, a rolling trolley wheel, moving along the under side of the trolley wire could not be used; two other systems were tried; sliding contacts, making contact with the upper side of the trolley wire, and lateral sliding contacts; the latter were found to be the better. Trials were made with three voltages on the line—750, 2000 and 10,000. Speeds up to 37 miles per hour were tried. The locomotive had two three-phase motors, each of 30 horse-power normal and of 120 horse-power maximum power at 650 volts; the characteristic curves of the motors are given in a diagram. The principal results of the trials are said to be that it was proven to be well feasible to take the current off from the trolley wire at a voltage of 2000 to 10,000; the devices for this purpose were found entirely practical; the sliding contacts were found to work better at 10,000 volts than at a lower voltage. The starting of the locomotive, which weighed 35,200 lbs., up to a speed of 37 miles per hour, with 30 tons of load, required 60 seconds at 700 volts and 190 amperes. The starting of the locomotive alone up to a speed of 25 miles required 14 seconds at 640 volts and 180 amperes, and up to a speed of 37 miles, 30 seconds. When running with a load of 30 tons at a speed of 37 miles, the voltage was 700, the current 70 amperes, the power factor of the motor 0.8.—*Elek. Zeit.*, June 7.

3000-Volt, Three-phase Railway.—E. K. Scott.—An article on the exhibit at the Paris Exposition of the plans, details of the cars, etc., for the 65-mile, three-phase railway at Colico, Italy. The line itself will not be ready for use before the end of 1901, but an experimental line of one mile has been erected some six months ago by Ganz & Company at Budapest, on which all the details are being carefully worked out. The transmission will be at 20,000 volts and in 10 transformer stations along the line the pressure is reduced to 3000 volts, at which voltage the current is supplied to the motors on the car (see also Digest Apr. 7.) The two overhead wires are 3 ft. apart and the rails form the third conductor.—Lond. *Elec. Rev.*, June 8.

Central London Railway.—A continuation of the illustrated article noticed in the Digest, June 23. The three-phase alternators are described, the efficiency curve, the volt-ampere curve and the magnetization curve being given in diagrams; the switchboard is described in detail. The advantages of the system (as already noticed, three-phase transmission at 5000 volts with converter sub-stations for supplying continuous current at 500 volts to a third rail) over other systems are shown. The direct application of polyphase motors on the locomotives would not have been economical, as the induction motor is at its worst when getting up speed, which is practically the whole duty of the motors on this line, there being 13 stations in less than six miles. Some information is given about the transmission line.—Lond. *Elec. Rev.*, June 8.

Electric Traction under British Conditions.—An editorial on Sayers' paper (Digest, June 9, 16). The chief factor which produces special conditions in Great Britain, are the regulations of the Board of Trade. The United Kingdom is said to be "now setting an example to all the world in solid and thorough work" in electric traction. Sayers' paper is said to deal with a particular case and the conclusions derived therefrom are not of general applicability; especially his advocacy of multiple power stations in preference to a central power station for the entire tramway system is criticized.—Lond. *Elec.*, June 8.

Electrolysis by Tramway Return Currents.—IRVING.—An abstract of a paper describing the arrangements adopted by the Bristol electric tramways for prevention of the electrolysis of gas and water pipes. The tram rails are "fished" together with no less than five plates, one on each side of the web in the usual manner, and one covering the entire underside and two strips on the upper side of the bottom flange of the rail, bolted up with 14 bolts. The rails are double-bonded at each joint with copper bonds 7-16-in. diameter, electrically connected to the web of each rail. There is also a third electric connection formed by Edison's plastic bond, carefully prepared and fixed between the rail and the fish plates. In addition to these bonds, and in order to make certain of one continuous conductor, a double cross copper bond is fixed every 120 ft. length of rail, so that should any individual rail bond fail, the cross bonds, which are each 7-16 in. in diameter, will take up the current. $1.75 per single joint is being spent in electric bonds by the traction company. In addition to this system of rail-bonding, a negative booster has been installed as noticed in the Digest June 23. The clauses in the Bristol Tramway act which were inserted for the protection of the gas and water companies, are reprinted. The potential difference between the points of the uninsulated return furthest from and nearest to the generating station, does not now exceed from 2 to 3 volts.—Lond. *Elec. Rev.*, June 8.

Electric Launches.—ECK.—A brief communication in favor of electric boats on the Thames, and giving some figures based on results obtained with the Callow-Eck system of electric launches. For a service on the Thames between Greenwich and Battersea, at five-minute intervals in large and safe boats, the cost per passenger mile, including all charges, allowing for the boats to be on the average only one-fifth full, would be 0.32 cent.—Lond. *Elec.*, June 8.

REFERENCES.

Automobile.—ZECHLIN.—An article on some points in the general design of automobiles; he recommends to decrease the weight of the vehicle as much as possible and to use ball-bearings. For electric automobiles great diameters of the wheels are recommended, while for gasolene motor cars smaller wheels are better; the reason is that for starting and climbing up hills smaller wheels are better when the motor cannot stand a great overload.—*Centralblatt fuer Accum. und Elementenkunde*, June 1.

Rail Bonds.—HECKER.—An illustrated communication describing the Reger bond, which is said to have all the advantages of the Bryan bond and besides to be cheaper.—*Elek. Zeit.*, May 17.

Southampton.—A well-illustrated article on the municipal electric railway system of Southampton, which was already described in the Digest, Apr. 21.—Lond. *Elec. Eng.*, June 8.

Accessories of Electric Traction.—COTTRELL.—A continuation of his illustrated serial (Digest, June 23), dealing with circuit breakers, switches, switchboard instruments and rheostats.—Lond. *Elec. Rev.*, June 8.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Free Wiring.—HOADLEY.—An article describing the disappointing results, obtained at Worcester with "free wiring;" the chief reason seems to be that the extra charge of 2 cents per kw-hour on all electric power consumed was practically an addition of 25 per cent to the electricity bills. The private free wiring company will now stop its operation in that town and the council has decided to go in for a scheme of assisted wiring on a sort of hire-purchase agreement. The work is to be done by local wiring contractors to the designs of the municipal electric lighting department; the consumer has to pay down on completion of the work one-tenth of the cost of the installation, and the balance can, at the option of the consumer, be spread over three, five or seven years, and paid by quarterly installments. On the rental system, a sum of 31 cents is charged annually for every lamp installed on the premises of the consumer. It is pointed out that by the former free-wiring system the best consumers, those who use a large number of kw-hours per lamp installed, were penalized most. The subject is discussed also in a long editorial.—Lond. *Elec. Rev.*, June 8.

REFERENCES.

Starting Shunt Motors.—BELTER.—An article, illustrated by diagrams, giving the connections for starting a shunt-wound motor without a special starting rheostat; the current is supplied by an accumulator battery and a switch must be available, as used for switching in and out parts of the battery.—*Elek. Anz.*, May 20.

Carlisle.—BURNET.—A paper giving a well-illustrated description of the municipal electric lighting station at Carlisle. The low-tension, three-wire, direct-current system of supply is used.—Lond. *Elec. Eng.*, June 8.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Wiring Tables.—W. R.—Three tables, one giving the current in amperes required by lamps of different candle-power and designed for different voltages; the second giving the size of wire required for any number of 16-cp, 110-volt lamps, with the average loss of 12 per cent at any distance from 50 to 200 ft.; the third giving similar information regarding 16-cp, 50-volt, alternating-current lamps.—*Can. Elec. News*, June.

Wire Winding.—An illustrated description of a simple apparatus for maintaining the tension on the wire when winding bobbins for electromagnets, etc. There are three grooved pulleys, placed triangularly on an iron frame, and two spiral spring guides, the wire passing through the latter.—Lond. *Elec.*, *Elec. Rev.*; June 8.

ELECTRO-PHYSICS AND MAGNETISM.

Dielectric Hysteresis.—BEAULARD.—A French Academy paper on the loss of power in a dielectric. A dielectric heats up in an alternating electrostatic field, and the heat is proportional to a certain power of the e. m. f., say, the x, the power; "but while, according to Steinmetz, x is constant and equal to 2, it seems to result from researches of Arno that x—equal to 1.65 for a field of 1.75 electrostatic units—is variable with the field strength and increases with increasing field strength, and in all cases the existence of a dielectric hysteresis might be admitted." (In his Alternating-Current Phenomena, second edition, page 145, Steinmetz says that probably the loss of power in the dielectric consists of two distinctly different components; one, the dielectric hysteresis, directly proportional to the frequency; while the other, a viscous loss, is proportional to the square of the frequency. He observed the latter loss in a high electrostatic field and high frequency. Arno observed the former loss at low frequencies and low field strength. In both observations the other component may have been very small.) Janet has submitted a condenser to cyclic processes of charges and discharges, and found that with increasing potential the charge is smaller than when the potential is decreasing; this lag of the charge behind the potential difference may be due either to hysteresis or viscosity; to decide between these two alternatives, the relation between the loss per cycle and the frequency may be used, as the hysteresis loss per cycle must be independent of the frequency and the viscous loss per cycle must depend upon the frequency. Beaulard has made experiments with a condenser; the one plate was held continually at a zero potential, while the potential of the other plate was varied from zero to a maximum potential, back to zero and further to an equal negative maximum potential, and back to zero. The time of such a cycle varied between 4 and 600 seconds. He made three series of experiments, the maximum voltage being 8, 18, 27, respectively. The electrostatic charges at different points of the cycle were measured with a ballistic galvanometer. Eight points were determined for a cycle and the curve drawn through them, the voltage and the charge being the co-ordinates. From these curves the loss of energy per cycle was determined. He found that the loss per cycle is the smaller, the longer the period; for a period of 15 minutes the loss was zero. He concludes that there is no dielectric hysteresis, but only dielectric viscosity.—*L'Eclairage Elec.*, May 12; very briefly in *L'Ind. Elec.*, May 10.

Electric Arc.—An editorial note on Child's dissociation theory of the electric arc (Digest, Apr. 14), according to which the work done by the current against the alleged counter e. m. f., within the carbon arc, is the result of the transference or movement of freshly dissociated ions along the path of the arc, the positive ions having to be pushed up by the impressed e. m. f. into the region of highly positive ions, and the negative ions having to be pulled down, as it were, into the region of highly negative-charged ions. "This explanation is beyond question ingenious, but it can only be held to settle the hypothesis of a counter e. m. f. by substituting a different phraseology for what is practically an identical phenomenon," as an e. m. f. is under no necessity to be found at any one particular point; but a counter e. m. f. may represent the line integral of the work done in moving a charge along any path where it encounters "opposing electric force."—Lond. *Elec.*, June 8.

Velocity of Ions.—ZELENY.—An account of a determination of the velocity of ions in a gas ionized by Roentgen rays, by balancing them against the velocity of a stream of gas. The gases studied were air, oxygen, carbonic acid and hydrogen, both moist and dry. The presence of moisture diminished the velocity, except that of the positive ions in air and carbonic acid. The ionic velocities obtained range from 0.76 for carbonic acid to 8 cm per second for hydrogen in a field of 1 volt per cm. The negative ion is the faster, except in moist carbonic acid, but the charge of both is equal.—*Proc. R. Soc.*, Apr. 14; abstracted in Lond. *Elec.*, June 8.

Radium Rays.—BECQUEREL.—An account of experiments relating to the penetration of radium rays. He had found that the transmission of radium radiation across a screen is attended by several distinct phenomena—selective absorption, diffusion, emission of secondary rays, some of which are deflected by a magnet, while others are not; and, finally, a direct transmission of part of the radiation from the source; the transmitted portion appeared to be identical with the incident radiation and suffered the same deflection by a magnetic field. This identity has been doubted by Villard, but has been confirmed now by Becquerel, who repeated his former experiments in a modified form.—*Comptes Rendus,* Apr. 30; abstracted in Lond. *Elec.*, June 8.

Double Nature of Radium Rays.—VILLARD.—A description of an experiment showing the heterogeneous nature of the rays given out by radium preparations. Radium rays are transmitted through a slit in a lead plate, and impinge at nearly grazing incidence upon two sensitive plates laid one over the other and wrapped in black paper. The rays are exposed to a strong magnetic field. The upper plate thus receives rays which have traversed the black paper only, while the lower one receives rays which have traversd in addition the glass and film of the upper plate, and an increasing thickness of both as the angle of incidence increases towards the edge. On development the upper plate shows two impressions, one deviated and spread out, the other feebler, but absolutely rectilinear and sharp; on the lower plate only one impression is visible, that due to the non-deflected rays. He calls the two classes of rays Roentgen rays and cathode rays.—*Comptes Rendus,* Apr. 30; abstracted in Lond. Elec., June 8.

Atomic and Molecular Magnetism.—An account of a continuation of his researches noticed in the Digest, Aug. 5, Oct. 28, Mar. 10. Vanadium chloride is a somewhat feebly paramagnetic substance of susceptibility about one-quarter of that of nickel. Studies of gadolinium and samarium make it appear likely that both these metals contain traces of a new substance of very high susceptibility. In diamagnetic compounds the molecular magnetism shows a greater diamagnetic value than would correspond to the sum of the atomic magnetisms, in all cases where the combination is accompanied by a considerable expansion, as in the iodides of silver, mercury and lead. The converse was found in the case of contraction of volume, with salts of copper, so that the general rule is that volume expansion increases the diamagnetic character of a substance, and contraction emphasizes its paramagnetic character. The magnetic properties of the elements can therefore only be deduced from the elements themselves, or from compounds which undergo no change of volume during their formation.—*Ann. der Phys.*, No. 4; abstracted in Lond. *Elec.*, June 8.

REFERENCES.

Intrinsic Brilliancy of the Crater of the Arc.—PATEVAL.—An illustrated reprint of a portion of his long paper on standards of light, abstracted in the Digest, Mar. 31, Apr. 14, 28.—Lond. *Elec. Eng.*, June 8.

Atmospheric Electricity.—ELSTER AND GEITEL.—A paper giving an outline of their theory of atmospheric electricity, which was noticed in the Digest, Apr. 28.—*Phys. Zeit.*, Mar. 3.

Hall Effect.—MORETTO.—An illustrated account of experiments in which he confirmed Righi's results that the Hall effect is proportional to the main current down to 0.04 amperes, while it is relatively greater than should be expected from this proportionality, for smaller values of the main current. He proved the existence of the Hall effect also with the discharge of currents of a condenser.—*Phys. Zeit.*, June 1.

Cathode Radiation.—WIECHERT.—A long, illustrated French abstract of the German paper noticed in the Digest, Feb. 3.—*L'Eclairage Elec.*, May 19.

Diffraction of Roentgen Rays.—HAGA AND WIND.—A French abtract of the German paper noticed in the Digest, Sept. 23.—*L'Eclairage Elec.*, May 19.

Cathode and Anode Rays.—BATTELLI AND MAGRI.—An illustrated account of experiments with unipolar discharges in vacuum tubes. There are two kinds of rays produced: cathode rays and anode rays, which behave in different manner.—*Il Nuovo Cimento,* October; abstracted in *L'Eclairage Elec.*, May 19.

Automatic Coherer.—An article on the coherer of Tommasina, described in the Digest, June 2.—*Sc. Amer.*, June 16.

Ruhmkorff Coils.—HAERDEN.—A brief article giving some hints how to make them.—*Elek. Anz.*, May 20.

Half Ring Electromagnet.—DU BOIS.—An illustrated, French abstract of the German paper noticed in the Digest, Feb. 24.—*L'Eclairage Elec.*, May 19.

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Tanning.—A description of a recently patented process of Lucknow and Toerisser. "The process is one for making hides conductors of electricity by stretching them on a perforated metal plate, or effecting the same result by rubbing them with plumbago, and by precipitating in the inner tissue of the hide, by electrolysis, a metallic substance." The electrolyte for the tanning process consists of tannins or salts containing tannins; the tannage commences with a current density from 50 to 100 amperes per square yard of anode surface, and can subsequently be gradually increased; the pressure is about three volts.—*Kuhlow's German Trade Rev.;* Lond. *Elec. Eng.*, June 8.

REFERENCES.

Theoretical Electro-Chemistry.—HABER.—An article, illustrated by diagrams, giving an outline of Luggin's graphical method of applying the principles of thermodynamics upon the investigation of electrochemical processes, especially upon the relations between the e. m. f. of a galvanic cell and the chemical reactions which occur in it. The free energy and the temperature are used as co-ordinates.—*Phys. Zeit.*, June 1.

Storage Battery Problems.—An abstract of the paper of Wade (Digest, Apr. 14, 21, May 12) with some critical remarks by Peters.—*Centralblatt fuer Accum. und Elem. kunde,* May 1, 15; Peters' remarks are commented upon in an editorial note of Lond. *Elec.*, June 8.

Charging Accumulators at Constant Pressure.—HEIM.—Continuations of his very long serial (Digest, May 19), in which further experiments are described.—*Elek, Zeit.*, Apr. 26, May 3, 17, 24, 31.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Frictionless Motor Meter.—EVERSHED.—The first part of a long, illustrated abstract of his recent paper, a brief note on which was referred to in the Digest, June 16. After some general remarks on motor meters and their errors, he describes how he eliminates friction. There is friction of the axle bearings, friction of the brushes on the commutator, and friction of the counting train and gear connecting it with the motor axle. With an ordinary vertical axle the first is nearly all due to the bottom or step bearing, which is usually a rounded steel point resting in a jewel cup. In this meter the pressure of the axle on the bottom bearing is reduced to a few grammes by magnetically suspending the axle, armature, and brake. A top bearing is entirely dispensed with, the axle being "magnetically pivoted." The brush friction is enormously reduced by the use of a novel form of commutator, having elastic segments, against which the edges of two light and freely pivoted wheels roll to act as brushes. The friction of the train is entirely removed as a source of error; the train is driven by a simple electromagnetic device, whose speed of working is controlled by the speed of the motor, although there is absolutely no mechanical connection between them. These means have sufficed to reduce the friction from a value between 300 and 400 dyne cms. to less than 3 dyne cms., and he thinks the limit has not yet been reached. He refers briefly to other systems of magnetic suspension. He says that one of the worst troubles with all forms of suspension was caused by the magnetic axis not being absolutely coincident with the rotational axis, the latter being determined by the pivots. If the top pivot is removed, the axle is free to centre itself in a magnetically symmetrical fashion, and will then rotate about the magnetic axis. Any directional moment due to the axle and suspending pole not being perfect figures of revolution, will be enormously reduced by diminishing the diameters of axle and pole; and with diameters not much exceeding 5 mm. the supporting pole has no measurable directing influence upon the axle. To prevent the axle from accidentally coming into contact with the supporting

pole, a thin plate of non-magnetic metal is interposed between them; it is fixed immediately above the end of the axle, leaving a very small clearance. The supporting pole is adjusted until nearly the whole of the pressure on the step bearing is relieved; if the pressure is reduced to zero, a slight shake will jerk the axle up until it rests against the plate, where it will remain, since the upward attracting force increases as the space between the axle and supporting pole diminishes; it is therefore necessary to leave a few grammes weight unbalanced so that there is sufficient gravitational force downwards to pull the axle off the end-plate should it happen to rise into contact with it. He then discusses essential points in magnetic suspension of meter axles, and shows that the induction density in the magnetic device used for support must remain absolutely constant during rotation of the axle. The attracting pole must therefore be a figure of revolution with its axis coincident with the axis of rotation; he uses a cylindrical magnetized rod fixed with its lower end immediately above and in line with the cylindrical iron axle.—Lond. *Elec. Rev., Elec. Eng.,* June 8.

REFERENCE.

Localizing Faults in Submarine Cables.—SCHAEFER.—An article describing in detail three actual tests, by which he localized very variable faults in submarine cables by means of simultaneous observations; the importance of simultaneous testing is pointed out. The article is commented upon in an editorial note.—Lond. *Elec.,* June 8.

TELEGRAPHY. [illegible] SIGNALS.

Long-Distance Telephony.—Some editorial notes on the recent A. I. E. E. paper of Pupin. His experiments are briefly described, from preliminary abstracts of the American journals. Further numerical details are, however, awaited, before definite conclusions are drawn. For instance, "in the extreme case of the coils being too near to one another all the energy might be simply transmitted by induction from the first coil to the last, the capacity of the cable being perhaps sufficient to prevent the interference of the current waves transmitted by conduction."—Lond. *Elec.,* June 8.

REFERENCES.

Electric Traction and Submarine Cables.—HAY.—A brief, illustrated communication, describing an experiment he has recently made to show how insignificant the effects of electromagnetic induction are in an arrangement which represents the actual working conditions at Cape Town (Digest, Mar. 31, Apr. 14, 21).—Lond. *Elec.,* June 1.

High-Speed Telegraphy.—MUNIER.—The first parts of a long, illustrated serial on different systems of high-speed telegraphy.—*L'Eclairage Elec.,* May 19, June 2.

Railway Signals.—BOULT.—A very long, well-illustrated abstract of a paper in which he describes his magnetic system of signals, noticed in the Digest, Oct. 14.—*Eng. News,* June 14.

MISCELLANEOUS.

Germany.—KERSHAW.—An article on the German electrical engineering industry in 1899. In two tables he gives the capital and last dividend of the five leading German companies and an Austrian, company, and for comparison the corresponding figures of the six leading English companies. While the capital of the five German companies is more than $60,000,000, that of the six English companies is $10,500,000; the last dividend of the German companies varies between 10 and 15 per cent, that of the English companies between 4½ and 6 per cent, that of the Austrian company is 25 per cent. Special features of the 1899 German reports are given, and the report of the Siemens & Halske Company is abstracted.—*Lightning,* June 7.

REFERENCES.

Metal Market.—Tables giving the fluctuations of the price of zinc, lead, iron, tin, copper, during the month of May.—Lond. *Elec. Rev.,* June 8.

Historical.—A. W. HEAVISIDE.—His presidential address to the Newcastle-on-Tyne local section of the British Institution of Elec. Eng., dealing with the position which that city and district have held in the electrical industry. The greatest part of the address is an outline of the development of telegraphy and telephony. The work of Swan and of Parsons is referred to.—Lond. *Elec., Elec. Rev., Elec. Eng.,* June 8.

Electrical Engineers in the War.—An illustrated article on the electric equipment of the British electrical engineers' volunteer corps for the South African war. Descriptions in English journals were noticed in the Digest, May 19.—*Elec. Rev.,* June 13.

Carborundum.—An illustrated article on the manufacture of carborundum at Niagara Falls.—*Sc. Amer.,* June 16.

Paris Exposition.—An illustrated description of a 2050-hp Siemens continuous-current dynamo at the Exposition, giving 2780 amperes at 550 volts.—Lond. *Elec. Rev.,* June 8.

An article on the exhibited plans and details of the three-phase railway at Colico, Italy (see the abstract under traction).—Lond. *Elec. Rev.,* June 8.

A description of an exhibited transformer for medical purposes (see the abstract under Dynamos and Transformers).—*L'Elec.,* June 9.

An illustrated description of the power-generating plant.—*Sc. Amer. Sup.,* June 16.

New Books.

TRASMISION ELEKTRIKA DE POTENZIA A LARGAS DISTANZIAS. Sobre La Manera De Kalkular Industrialmente Este Jenero De Instalaziones. Por A. E. Salazar, Profesor De Fisika Industrial De La Unidbersidad De Chile. Kon una tabla orijinal sobre el konsumo de kobre en las trasmisiones polifases. Santiago de Chile: Hume I K A. 95 pages.

This is an excellent little treatise in the Chilian language. The Chilian is practically the same as Spanish, with the letters c, h, q and v omitted and the initial *r* doubled before a vowel. The book is divided into five chapters, as follows: I.—Introduction. II.—Computation ot the Conductor. III.—Computation of the Poles. IV.—Additional items (hydraulic). V.—Determination of the cost price of energy transmitted.

The treatment is essentially arithmetical, clear and precise, and the little treatise is probably the best in the Spanish literature, and quite up to date. Aluminum wire is discussed.

Two tables appear at the end of the treatise. Table I., pp. 74-75, gives the copper in metric tons required to transmit one kilowatt at various direct-current pressures from 1000 to 7000 volts to distances up to 20-km. Table II., pp. 78-87, gives the copper in metric tons required to transmit one kilowatt at various triphase alternating-current pressures up to 40 kilovolts, and four different power factors (1, 0.9, 0.8, 0.7), to various distances up to 200-km.

It is very refreshing to see such good electrotechnical work being published so far south of the equator.

THE LAW OF ELECTRIC WIRES IN STREETS AND HIGHWAYS. By Edward Quinton Keasbey. Second edition, revised and enlarged. Chicago: Callaghan & Company. 358 pages. Price, $5.00.

When Scott and Jarnagin published a compilation of law relating to telegraphs about 1869, they thought it necessary to only casually refer to the location of supports and wires. Some time prior to 1890, when the first edition of Mr. Keasbey's book appeared, the legal status of several questions regarding the rights and liabilities of a party seeking to establish a line of electric conductors for the rapidly multiplying commercial uses of electricity was in litigation in many States, and had assumed greatly increased importance; but many questions then new have now been judicially settled.

Mr. Keasbey has in his second edition brought these decisions down to date, and has discussed later questions that have assumed practical importance, such as the power of a municipality over the use of streets for light and power conductors; the power of condemnation where private rights are involved; the location in proximity of conductors carrying interfering currents, such as an alternating power or light conductor and a telegraph or telephone wire; the liability of the constructor for injuries arising by reason of negligent construction; the use of dangerous currents, and the almost universally troublesome problem involving the power of the State to impose license fees and franchise taxes.

The power over the streets for electric conductor purposes being in the legislature, a municipality has only what is delegated, and cannot grant an exclusive, indefinite and irrevocable franchise unless explicitly authorized by the legislature, and in some cases it has been held that a city has no right to do this even for a limited time. It seems well settled that when a legislature has authorized the use of the streets for electrically-propelled cars, the city has the implied power to permit the erection of poles and wires. Regarding telegraph and telephone wires, it is not clear that the general powers over streets usually given a municipality include the power to permit the

erection of such wires; the power to permit the erection of electric light wires has not been questioned, however. The text seems to be ably and carefully prepared and the references to the decisions have been carefully and conscientiously made.

Digest of United States Automobile Patents. Compiled by James T. Allen, Examiner U. S. Patent Office. Washington, D. C.: H. B. Russell & Company. Full sheep, 713 pages. Price, $25.00.

To those interested in the manufacture of horseless carriages or traction engines, this compilation of United States patents made by Mr. James T. Allen, an examiner in the Patent Office, will possess great practical advantages. The work includes all patents relating to motor vehicles, from the very beginning of the issue of patents by the government up to July 1, 1899.

It is evident that Mr. Allen has devoted much time and labor in selecting such patents as cover horseless vehicles from the various classes of patents in the Patent Office, and the volume which he has produced is a handsome one of some 700 pages. About 500 pages are devoted to the drawings, which are photographically reproduced, and the remainder of the book contains a brief description of the inventions, all of the claims of the patents, with the number, date of issue and date of application. There is also furnished a complete index of the references cited against the patents while they were pending as applications, and "interferences," if any, are mentioned with the parties thereto and the decisions. In this compact form, fully indexed, the patent history of automobiles is disclosed in a very precise, convenient and satisfactory way, and cannot fail to be a great saver of time and money to those in any way interested in this rapidly growing art.

The patents are arranged chronologically under the heads of spring, steam, gas, air, electricity and gearing; while under the head of traction engines are given all of the traction engine patents, as classified in the Patent Office. This class, while of value to traction engine makers, is also useful to makers of automobiles, as many patents covering traction engines are applicable to the modern horseless carriage whatever the motive power may be. The book also contains a miscellaneous class of patents which include some especially pertinent, taken from various other classes.

It is interesting to note that the earliest patent issued by the United States, in this now very active industry, was granted in 1817; following this the patents did not become numerous until after the War of the Rebellion, and the great bulk of them appears to have been issued within the past few years.

In the back of the volume is given a list of patents on portable engines, electric locomotives, etc.; but the compiler has, as a rule, omitted apparatus designed especially for vehicles to be run on a track, but has inserted a list of many of such patents which will prove interesting as bearing upon the art. There is also a list of patents on battery systems.

The work of reproducing the drawings has been well done. They are perfectly clear, and are exact reproductions of the original drawings filed at the Patent Office; the complete drawings of each patent are given. The Digest of Automobile Patents subsequent to July 1, 1899, is continued by Mr. Allen, in the form of a monthly publication.

Glover's Wiring Tables. The British firm of W. T Glover & Co., Ltd., of Salford and Trafford Park, Manchester, has recently issued a revised edition of its wiring tables for British gauges which seem to be very convenient for engineers in Great Britain, and may be used to advantage in this country, also, for comparison. There are two tables, one for pure copper wires and town lighting cables, the other for pure copper cables. The table of the copper wires of British gauges gives the diameter, the area, the amperes at 1000 per square inch (for loss of 2½ volts per 100 yards), the amperes at I. E. E. standard current, the relation between weight and length, those between length and resistance, and those between resistance and weight. The table of pure copper cables gives the number of strands and size, the amperes at 1000 per square inch of solid conductor (loss 2½ volts per 100 yards), the amperes at I. E. E. standard, the diameter of each wire, the diameter of the strand, the effective area, the standard resistance at 60 degs. F., the maximum resistance allowable (2 per cent above standard resistance), the standard weight, and the minimum weight allowable. The tables have been calculated from the formulas adopted by the British Committee on Copper Conductors in May, 1899, which consisted of representatives from the British General Post Office, the British Institution of Electrical Engineers and eight prominent manufacturers of rubber-insulated cables in the United Kingdom. The type is clear, and the lines are printed alternately in blue and red ink for convenience. We notice a move toward the adoption of the metric system, in that the diameters are given in both inches and millimetres, the areas in circular mils, square inches and square millimetre, etc.; the pound, however, is used exclusively throughout.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Next meeting, Paris, Aug. 16, 1900.

Canadian Electrical Association. Next meeting, September, 1900. Place to be selected.

Northwestern Electrical Association. Last meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

American Street Railway Association. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

National Association of Municipal Electricians. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

American Electro-Therapeutic Association. Next meeting, New York, Sept. 25, 26 and 27, 1900.

New Type Delivery Wagon.

The accompanying cuts give a general view of a new electrical delivery wagon which is being operated by one of the large New York dry-goods stores, and details of the running gear. The wagon presents many novel features, not the least of which, as seen by the illustration, is its general appearance. The body is of the brougham type, with side doors, the batteries being placed under the seat and in the rear part. This arrangement allows the greatest possible

FIG. I.—ELECTRICAL AUTOMOBILE DELIVERY WAGON.

space for the storing of packages, the capacity being double that of the automobile delivery wagons formerly used by this house, although the length is only increased by 10 inches.

The running gear is an adaptation of the familiar pedestals used on locomotives, relieving all the fore-and-aft bending strain on the leaves of the springs. As shown in Fig. 2, there are no reaches connecting the axles, so that each is free to move independently of the other, and thus no destructive strains are transmitted to the gear. The pedestals are bolted to the sills and take directly all the strains

of driving and those encountered on rough roads. A further advantage is that they allow the wagon body to be placed lower than would be otherwise possible, which adds materially to the appearance.

Forty-four cells of chloride battery are used. They are contained in four crates, three of which are disposed in the back of the vehicle and one under the seat. The motors and controllers are of a special type made by the General Electric Company. The two motors are of 2-hp each, geared to the driving wheels by rawhide pinions to minimize the noise. An internal expansion brake is used which is claimed to be able to stop the wagon in about its own length without undue effort. This brake will not drag, and is placed on the driving wheels—not on the pinions.

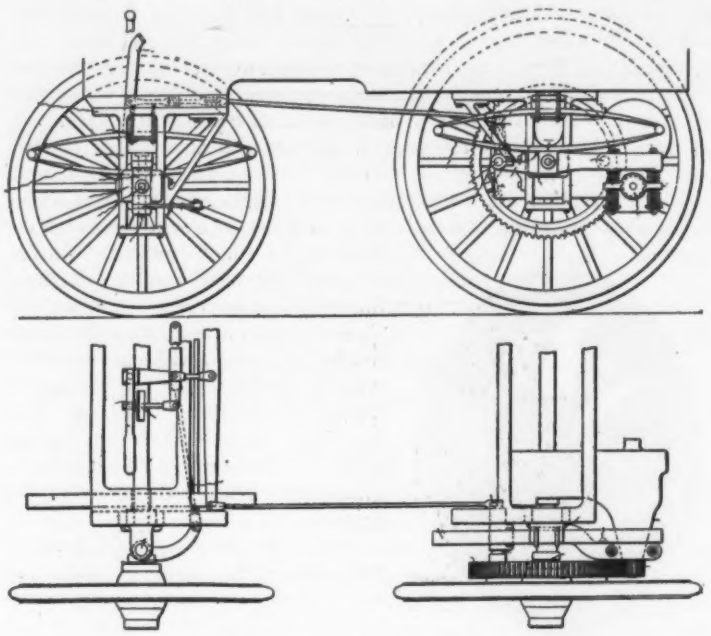


FIG. 2.—RUNNING GEAR.

The finish and upholstery have been given particular attention. Owing to the purpose for which it was designed, the vehicle has a speed of but ten miles per hour. The battery has a capacity sufficient to last for 30 miles without recharging. The total weight, empty, is 4500 pounds, and 1000 pounds may be carried exclusive of the driver and delivery man.

The wagon was designed and built by Frederick R. Wood & Son, of New York, the engineer of the company, L. T. Gibbs, being the inventor and patentee of the pedestal gear.

An Electric Kitchen.

Recently the largest electric kitchen installation thus far made, was put in operation in an apartment house at Utica, N. Y. Prior to the adoption of electrical cooking apparatus, a sample outfit was used for several months by the tenants of the same landlords in another apartment house, and it was on the result of this experience that the order was given for thirty equipments. The accompanying cuts give plans and elevation of the kitchen referred to.

The stoves are of the American Electric Heating Corporation standard, made with a slate base. The ovens, which weigh, including base and all, less than 25 pounds, are asbestos lined. The maximum current required for the oven is 10 amperes at 110 volts, or 5 amperes at 220 volts, arranged for three gradations of heat; for all ordinary operations the equivalent of about one-third of the maximum current is required for the period of cooking the food. In actual practice the maximum current is turned on to heat quickly, and then reduced or cut off entirely, according to the cooking operations that are going on. For baking biscuits, pies, cakes, etc., the current is usually turned off entirely during about one-half the operation; for roasting meats it requires some current on during about two-thirds of the operation.

The peculiar advantages of this outfit are that it requires little in the way of special arrangement for installation, as the receptacles for the plug switches of a required number can be furnished, and mounted on a slate slab to which the main line connection is made. An ordinary wooden-top kitchen table answers all requirements for supporting the apparatus, and as all articles can be detached from the receptacles, they may be easily removed from the table and the table utilized for other purposes.

Another advantage that is much appreciated, especially under the condition of modern apartment-house construction, is that, regardless of the size of the room, there is no appreciable heat from any of the apparatus when in use. In the case of a gas stove, the best possible efficiency claimed never exceeds 20 per cent, the other 80 per cent of the heat being wasted, and incidentally raises the temperature of the room as well as vitiates the atmosphere—unless properly piped; under best conditions the gas range forms a large radiator, while in the case of the electric apparatus, only the part doing the work is heated, and the cooking operation practically absorbs all of the heat. The different cooking operations with electric apparatus show an efficiency anywhere from 50 to 80 per cent. In the case of the oven the efficiency is even higher when roasting, or when in service for any material length of time.

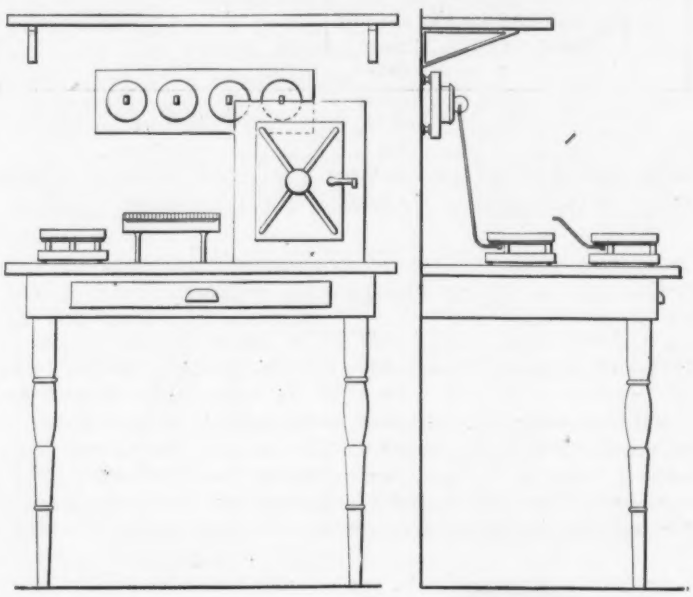


FIG. I.—ELEVATION OF ELECTRIC KITCHEN.

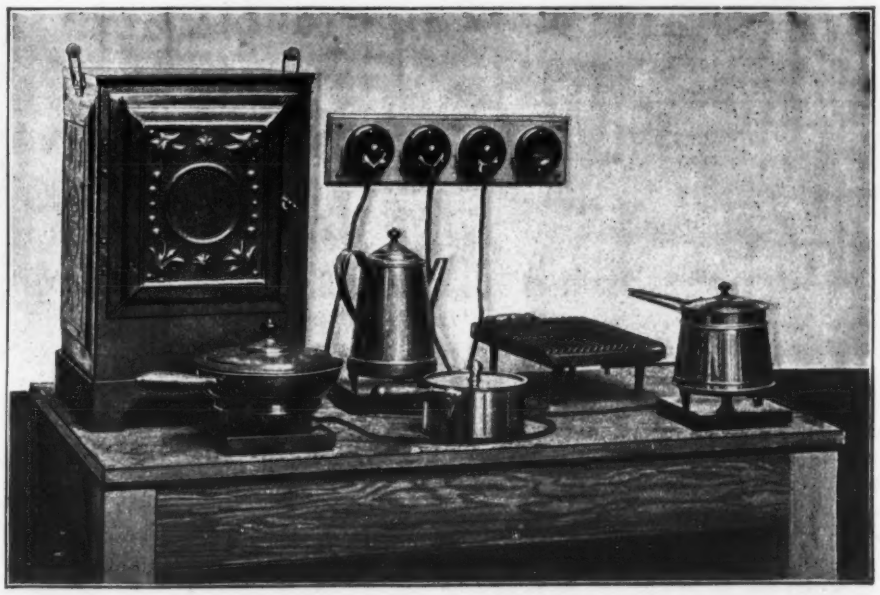


FIG. 2.—ELECTRIC KITCHEN.

Cooking-school teachers and lecturers claim that they get advantages in cooking by electricity which are not realized by other methods of cooking. Such statements have been voluntarily given

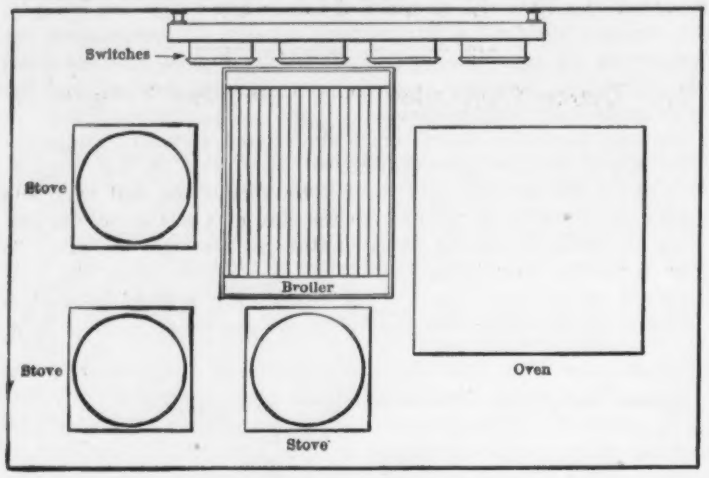
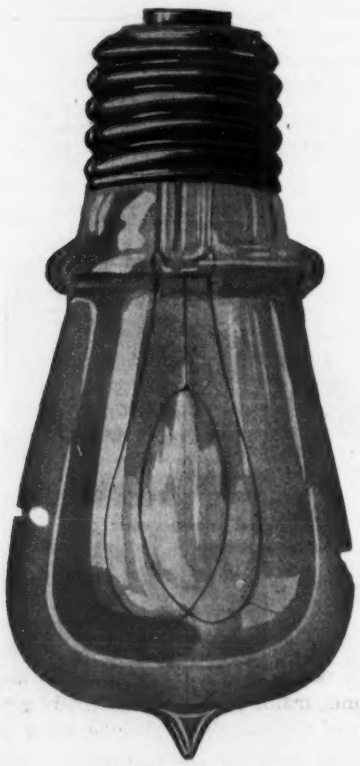


FIG. 3.—PLAN OF ELECTRIC KITCHEN.

in the cooking-school journals many times by the leading authorities, such as Mrs. Rohrer, Mrs. Lincoln, Helen Johnson, and others.

G. I. Special Sign Lamps.

Manufacturers of electric signs usually experience trouble during wet weather, with short circuits in the bases of the incandescent lamps used. Signs are commonly made tight at the back, and as far as possible around the receptacle. It has not been possible, however, to secure an absolutely water-tight fit between the lamp and the receptacle. To overcome this difficulty, Mr. Chas. A. Chase, of Chicago, has devised an arrangement, the main feature of which is the enlargement or annular ring around the neck of a lamp bulb, as shown in the accompanying illustration. A rubber ring or gasket placed in front of this shoulder, is compressed when the lamp is put in the receptacle, thus forming a tight joint between them. The electrical contacts of the lamps and the conducting portions of the socket are, therefore, protected from moisture.



SPECIAL SIGN LAMP.

While these lamps are intended especially for signs, they may be used to advantage in all outdoor work, as well as for industrial purposes, as in breweries, and chemical works, where dampness or corroding gases make the use of electric lamps difficult.

The friction of the rubber against the abutting ring on the bulb and the socket, also prevents the lamp from becoming loose in the receptacle. Those who have had experience with electric signs will readily recognize the advantages obtained by the use of this specially-designed bulb.

These special lamps are made in bulbs of two sizes; the larger being shown in the cut and is 1¾ ins. in diameter by 4 ins. over all —made in all voltages from 45 to 130, and in candle-powers from 4 to 10 inclusive. The smaller size lamp is 1½ ins. in diameter and 3 ins. in length over all, and is made in candle-powers from 2 to 6 inclusive.

The recent exhibit of the letters "G. I." fitted with these special sign lamps, at the National Light Association, Auditorium Hotel, Chicago, caused a great deal of favorable comment.

A New Type of Electric Ventilating Fan.

The B. F. Sturtevant Company, of Boston, has during the past year remodeled its enclosed motors designed for direct-connection to propeller fans, and is now building a full line of these machines, ranging from 18 ins. to 120 ins. in diameter, with capacities from 2000 to 175,000 cu. ft. The motor is of the bipolar type, entirely enclosed, and thereby protected from dust, a most important element in a machine used under these conditions. In order to avoid the excessive temperature which is incident to the operation of most enclosed motors, this type has been very carefully designed, so that a low temperature rise can be maintained without greatly increasing the size and weight above that of the ordinary open type. This machine is capable of continuous operation for 10 hours, with a maximum temperature rise not exceeding 60 degs. F.

FIG. 1.—VENTILATING FAN.

Yokes extending out from the field ring support the armature shaft. The end casings are entirely independent and can be instantly removed to give access to the entire interior. The bearings and brushes can be reached by simply removing the caps in the centre of the casings.

The brushes are of hard carbon, in holders of a modified reaction type, which allows of easy adjustment when it becomes necessary to reverse the direction of rotation of the motor. The bearings are self-oiling and self-aligning and fitted with composition sleeves, which are removable from the outer ends of the boxes.

The design of the propeller wheel is the result of an extended series of comparative experiments with different types. The delivery edge is helical, and the form is such that the air is picked up at the inlet edge of the blade at low velocity, and when well under the influ-

FIG. 2.—VENTILATING FAN.

ence of the blade is accelerated to its maximum velocity with the least amount of slip. As a result, the efficiency is extremely high. The wheel is partially enclosed within a conoidal inlet ring, which decreases the frictional resistance to the entering air. By means of a tripod support the motor is accurately centered and rigidly held in place, and the entire apparatus may with ease be bolted directly to the wall, through which the air is to be discharged. The illustrations serve to make clear the general features of the design.

United Electrical Contractors' Association.

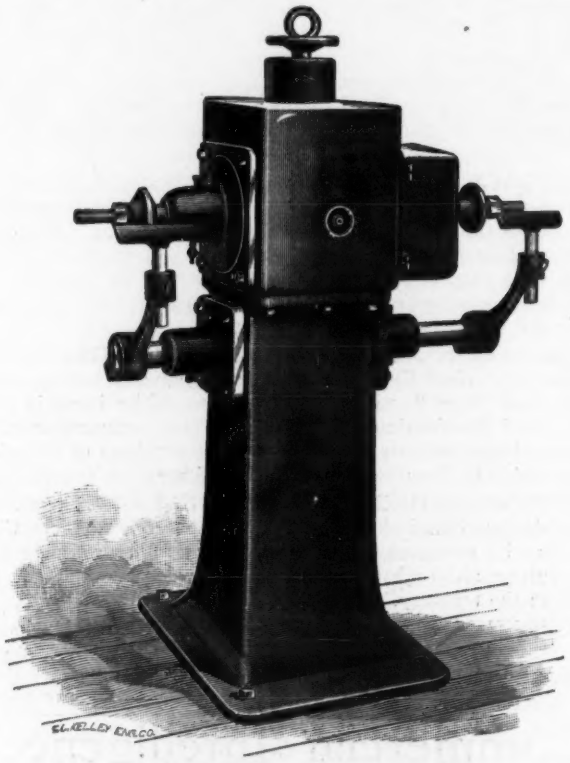
The United Electrical Contractors' Association of New York State met in convention at New York, June 20. After the business had been transacted at the session in the morning, the delegates and their friends were taken for an automobile ride up as far as Grant's Tomb, in Riverside Park, and from there they were taken aboard the steamer Mohawk and treated to a delightful sail down the Bay as far as the Narrows. From there the steamer went up the East River to Fort Schuyler, and, returning, landed at East Thirty-first Street, at 6 p. m. Conterno's Band was engaged for the occasion, as well as other musical talent, and the outing was rendered an exceedingly pleasant one for all the guests, whose comfort and enjoyment were looked after by a committee composed of J. R. Strong, J. C. Hatzel, C. L. Eidlitz, E. S. Keefer and F. L. McCutcheon.

In the evening a banquet was held at Sherry's, and was attended by about 150 persons. The dinner was followed by a vaudeville entertainment given by selected metropolitan artists.

Delegates were present from Buffalo, Utica, Troy, Albany and other New York cities, and the meeting was the most successful ever held by the association.

Electric Emery Grinder.

The machine shown in the accompanying illustration consists of an electric motor connected with two emery wheels, one at each end of the motor shaft. The motor is of the iron-clad, multi-speed type, manufactured by the Stow Manufacturing Company, Binghamton, N. Y., which company also makes the complete machine as illustrated. The machine drives two 2 x 14-in. emery wheels at any speed from 960 and 1600 revolutions. Starting when the wheels are new



ELECTRICALLY-DRIVEN EMERY GRINDER.

at the proper speed for grinding, as they wear away, the speed may be increased to maintain the proper peripheral velocity, thus allowing the emery wheels always to act to the best advantage. The machine can be placed in any situation most convenient for its use, and if desired can be moved at will from time to time. The machine is provided with a simple locking device which places it absolutely under the control of the foreman or person having the key in charge; thus no change in the speed can be made by careless workmen, thereby preventing unnecessary speeding up and consequent danger of the wheel bursting.

The speed of the motor used is regulated by varying the magnetism in the centre of a pole piece, which is done without altering materially the commutating field at the pole corners. This permits a wide variation of the speed without decreasing the efficiency of the motor. This regulation is effected by moving up or down the plunger shown at the top of the machine, which changes the air-gap between the end of the plunger and the armature.

The Detroit Convention of the Railway Telegraphers' Association.

One of the features of the recent convention of the Railway Telegraphers' Association at Detroit consisted of an excellent exhibition by manufacturers and dealers of apparatus and material relating to railroad telegraphy and signals.

A SINGLE MAGNET RELAY AND SOUNDER, the invention of Mr. J. L. Cutler, of New York, were exhibited in actual operation on one of the Michigan Central Railroad wires.

THE BUNNELL TELEGRAPHIC & ELECTRICAL COMPANY, of New York, represented by Mr. D. C. Bunnell, showed samples of telegraph instruments. Mr. Bunnell distributed as a souvenir of the occasion, a neat pocketbook of Russia leather.

THE AUTOMATIC CLOCK COMPANY, of Chicago, Ill., was represented by Mr. W. C. Bryan, the manager. The exhibit consisted of automatic electric clocks. The clocks made by the company have but three wheels, and are so constructed as to provide for heavy vibrations of buildings, thus making them practical and true timekeepers for railroad purposes.

THE TELEPHONE, TELEGRAPH & CABLE COMPANY OF AMERICA, the new interest in telephonic and telegraphic circles, was represented at the convention by William Stanley Eckert and Geo. W. Beers. This company, it will be remembered, recently purchased the control of the Erie Telegraph & Telephone Company, the largest of the Bell lessee companies.

THE ERICSSON TELEPHONE COMPANY, of 296 Broadway, New York, was represented by Messrs. J. H. Montague and J. F. Hemenway, and made a fine display of telephones and telephonic appliances, including a complete working exchange. A large number of instruments of various types were connected with a switchboard, and the operation of the board thus clearly illustrated.

MR. H. BLOARE, of Wymone, Neb., exhibited a galvanic battery insulator consisting of a circular glass tray suspended between the copper and zinc elements of the battery. This device is claimed to increase the efficiency of the battery fully 40 per cent and to decrease the consumption of the zinc 25 per cent, and that of blue vitriol 33⅓ per cent. To clean a battery, it is only necessary to remove the zinc (the glass insulator being attached to it), empty the deposit and return the zinc to its proper position.

THE RAILROAD SUPPLY COMPANY, of Chicago, Ill., was represented by Mr. E. W. Vogel, signal engineer; Mr. Walter Dixon, Cincinnati representative, and Mr. H. H. Hart, mechanical engineer. The company had a very handsome exhibit of its highway alarm, which is called the "Chicago Crossing Signal." This serves two purposes, giving a visual, as well as an audible signal for protecting highway crossings against accidents, and judging from the demonstration given by Mr. Vogel, the alarm is applicable to any highway crossing, no matter what the situation of tracks, or other complicated conditions may be.

J. H. BUNNELL & CO., of 20 Park Place, New York, made an exhibit of a number of their specialties, including the new main-line sounding relay, recently placed on the market. They also exhibited a new form of Wheatstone bridge, called the Jones type. The advantages of this new instrument are the compactness and convenience of arrangement, and the omission of contact plugs, resistance being thrown in and cut out by means of radial switches having platinized contacts. The coils are arranged in series of units of ones, tens, hundreds and thousands ohms, making it easy to instantly get a balance by the simple movement of the switches. Among other exhibits, were a new form of pony relay with adjustable magnets, pocket relays, graduating coils, a vest-pocket wire calculator, and a new form of steel pole for telegraph and other conductors. As souvenirs of the occasion, special watches with the imprint of the house and the symbol "73" on dial were distributed, as well as handsome card cases. For the ladies, they had an agreeable surprise in the shape of an entirely new design of change purse, which proved very acceptable. The house was represented at the convention by Mr. C. McLaughlin and Mr. J. J. Ghegan.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a comparatively small volume of transactions in stocks, but the fluctuations in quotations were unusually wide. The prominent feature of the market was Brooklyn Rapid Transit, which sustained a net loss of over 16 points in the two business days of the week. One of the supposed causes of the campaign against this stock is that it is for the purpose of securing control, on the theory that the Metropolitan Street Railway Company desires to eventually manage the entire local traction system of Greater New York. In the money market, time loans showed a slightly firmer tendency, the general demand for money, however, being moderate. Call money has ruled at from 1 to 1¾ per cent, and is freely offered at 1½. In time money the offerings are somewhat reduced, and quotations are 3 per cent for all dates up to ninety days and 3½@4 per cent for longer periods. Mercantile paper is fair in demand, with moderate offerings; the rates are 3@4 per cent for indorsed bills receivable. In outside securities the only change recorded was a fluctuation in prices more than has been the rule of late, particularly toward the end of the week. This, however, was not accompanied by any increase in activity. Prices moved up or down, and most of the movements were toward lower prices, on transactions in a few hundred shares only. The narrowness of the market was marked, and was evidenced by fluctuations of many points between sales. The declines that occurred did not, however, lead to any substantial increase in the trading in the stocks that were affected. In the copper stocks there was some activity toward the end of the week, but the results show no important changes. Amalgamated Copper closed at the same figure as the closing quotations the week previous, Union Copper declined to 2⅛ and closed at 2⅛ bid. British Columbia Copper advanced a fraction, and Tennessee Copper closed at 12 bid, a net gain of 1 point. The results of the week's trading in the most prominent electric and traction stocks are shown below: Brooklyn Rapid Transit, net loss, 16⅛ points; General Electric, net loss, 3 points; Western Union Tel., net loss, ½; Metropolitan St. Ry., net loss, 6; Third Avenue, net gain, 1½; American Telegraph and Cable, net gain 2. The following were the closing quotations: American Dist. Tel., 25; American Tel. & Cable, 91¾; Brooklyn Rapid Transit, 51⅜; General Electric, 128½; Manhattan Elevated, 84¾; Metropolitan St. Ry., 146¾; Third Avenue, 110; Western Union (ex-div.), 78½. Outside securities: Commercial Cable, 150; Electric Boat, 14; do., pfd., 32; Electric Vehicle, 18; Electro-Pneumatic Transit, 2½; Gen. Carriage Co., 5; Hudson River Telep., 116; Ill. Elec. Veh. Trans., ¾; New England Elec. Trans., 3⅜; N. Y. Elec. Veh. Trans., 6½; N. Y. & N. J. Telep., 160; Otis Elevator, 27; do., pfd., 88½; Tel., Teleg. & Cable of Amer., 4½; Worthington Pump, 108. In Boston—American Telephone, 141⅞; Bell Telephone, 295; Erie Telephone, 96; Am. Teleg. Rights, 7⅛; Westinghouse Elec., 44; do., pfd., 61½; Massachusetts Elec., 22½; do., pfd., 75½. In Philadelphia—Elec. Storage Battery, 75; do., pfd., 80; Phila. Traction, 96½; Union Traction, 37⅜; American Railways, 5⅛; Brooklyn Gas & Electric, 3; Gen. Elec. Automobile, ¼; Philadelphia Electric, 3½.

DIVIDENDS.—The E. W. Bliss Company, Brooklyn, N. Y., will pay a 2½ per cent dividend on its common stock and a 2 per cent on its preferred stock, on July 2. The Metropolitan Street Railway Company, New York, has declared a quarterly dividend of 1¾ per cent, payable July 16. The directors of the American Telephone and Telegraph Company, which company is the successor of the American Bell Telephone Company, have declared a regular quarterly dividend of 1½ per cent, and an extra dividend of ¾ per cent, which is the same rate as paid on Bell Telephone stock, two shares of Long-Distance Company stock having been exchanged for one share of Bell Telephone stock. The dividends are payable July 16. The Hall Signal Company has declared a quarterly dividend of 1 per cent on the common stock, payable July 2. The Binghamton General Electric Company has declared a semi-annual dividend of 2 per cent, payable July 2. The directors of the New England Electric Power Company have declared a regular semi-annual dividend of 3 per cent, payable July 16. The directors of the Central and South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable July 2. The Westinghouse Machine Company has declared a quarterly dividend of 1½ per cent on preferred and common stock, payable July 10. The Union Switch and Signal Company has declared a dividend of 2 per cent on the preferred stock and 1 per cent on common stock, payable July 10.

TO INCREASE GENERAL ELECTRIC STOCK.—The directors of the General Electric Company have called a special meeting of the company, to be held in Schenectady, July 17, to authorize an increase in the common stock by $4,415,000, and with the proceeds to retire all the $5,298,000 outstanding debenture bonds. In June, 1892, the company issued $10,000,000 thirty-year, 5 per cent debenture bonds, but provided for their retirement in a stock issue, at the rate of one new share for each $120 represented in the principal of the debenture. The company has purchased and canceled from time to time $4,702,000 of these debenture bonds, leaving outstanding at the present time, $5,298,000.

METROPOLITAN OF KANSAS CITY.—A meeting of the stockholders of the Metropolitan Street Railway Company, Kansas City, Mo., has been called for Aug. 6, when it is likely that a financial reorganization of the company will be effected. It is necessary to raise $2,800,000 to change the road from cable to electric power, and it is desired to do this without assessing the stockholders. The proposition is that the property of the old company be sold to a new corporation with a capital stock of $10,000,000 non-cumulative 5 per cent preferred stock and $10,000,000 common stock. The outstanding stock of the company is $5,586,000.

CINCINNATI STREET RAILWAY TO INCREASE CAPITAL.—The directors of the Cincinnati Street Railway Company have recommended to the stockholders an increase in the capital stock from $18,000,000 to $20,000,000. Action will be taken at the annual meeting of the Company, July 25. It is proposed to make the first issue about Oct. 31. It will be of $650,000, to which the stockholders will be entitled to subscribe at par. The present authorized capital of the company is $18,000,000, of which $17,096,000 has been issued. The remainder is held in the treasury to redeem outstanding bonds to that amount.

ELECTRIC VEHICLE COMPANY.—At a special meeting of the stockholders of the Electric Vehicle Company, held in Jersey City, on June 20, the increase of the capital stock from $12,000,000 to $18,000,000 was approved. Of the new issue, $3,000,000 will be preferred stock, and the remainder common. The new stock, it is stated, is to be issued for the purpose of taking over the Columbia Electric Vehicle Company, of Hartford, and the New Haven Carriage Company, which is controlled by the Columbia Company.

MORTGAGE.—The Baltimore County Water & Electric Company has recorded a forty-year, 5 per cent gold bond mortgage for $1,000,000 to the Maryland Trust Company, trustee. The company was formed to furnish electric light, heat and power in Baltimore County, and supply water to various places in the county. It is a consolidation of the Chesapeake Electric & Water Company and the Catonsville Water Company.

INCREASE IN NEW ENGLAND TELEPHONE STOCK.—The Southern New England Telephone Company has increased its capital stock from $2,500,000 to $2,750,000. The issue is made to take care of the floating indebtedness of the company incurred by the recent improvements made and for the purchase of Suffolk plant and for rights in the northern part of the State..

NEW ENGLAND ELECTRIC VEHICLE.—It is reported in a Boston despatch that the New England Electric Vehicle Company is earning its expenses, and has prospects of a profitable business in the future, although the stock is selling for one-half the amount of cash in the treasury.

SECURITIES LISTED.—The New York Stock Exchange has listed $10,000,000 Western Union Telegraph Company 4½ per cent funding and real-estate mortgage 50-year gold bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—The leading features of the business situation last week, according to Bradstreet's summary, were midsummer dullness in distributive trade and industry, and further reductions of prices of manufactured goods, particularly iron and steel, and raw textiles, and a marked upward movement in nearly all agricultural products. Heavy increase in railroad earnings testifies to a large volume of business. For the second week of June, 61 roads report gross earnings of $8,880,000, an increase of 12 per cent over the corresponding week a year ago. In the iron trade, weakness of prices is still the leading feature, pig iron being lower. Structural material has declined from $7 to $9 per ton. Domestic orders are perhaps slightly more numerous, but are for small quantities. The other metals are practically unchanged in price, copper being quoted at 16c for Lake, 15¾c for electrolytic in cakes, wire bars or ingots,

5½c for cathodes, and 15½c for casting copper. The consumption of platinum is increasing and prices are strong, with a higher tendency. For ingot in large quantities $18.20 per Troy ounce is quoted in New York. Bradstreet's reports business failures during the week ended June 21, as 167, against 180 the previous week, and 199 the same week last year. The number of failures last week was smaller than for any week since 1896.

THE AMERICAN STOKER COMPANY, New York, has received an order from the Cleveland Illuminating Company, Cleveland, Ohio, for 24 mechanical stokers. This is the third order received from this company, and makes a total of 36 stokers. When filled, the Cleveland company will have all the boilers in its lighting station equipped with this apparatus.

THE DETROIT MICA MINING COMPANY, Dillsboro, N. C., has sold its plant to Dr. G. A. Munch, of Detroit, Mich. The old company was capitalized at $100,000. A new tunnel has been started, and it is understood that the new owner will make other improvements.

TURBINES IN GERMANY.—The United States Consul at Coburg, Germany, writes to the State Department that in these times, when coal is hard to obtain, American turbine-wheel houses ought to give special attention to supplying southern Germany with improved machinery for utilizing the water power which is now running to waste, especially in Thuringia. He advises that they send salesmen who can speak German and who know how to operate the machines. The only water-wheel known in the section referred to is, he states, the old-fashioned one.

CENTRAL-STATION PLANTS IN MEXICO.—H. H. Barnes, Jr., chief engineer of the Compania de Mexicana de Electricadad, is now in the United States for the purpose of making arrangements for the purchase of mechanical apparatus rendered necessary by some proposed alterations in the company's plant. The compania, the $2,000,000 of whose capital is largely composed of English and German money, holds the municipal contract for the supplying of electric light in the City of Mexico. Owing to the fact that Siemens & Halske have guaranteed a certain percentage of profit on the operating of the plant, the contract for the electrical equipment was granted them, and the Mexican city authorities undertake not to make any additional purchases elsewhere for a period of three years. It is said that the method pursued by the German concern in offering to make guarantees as to the financial success of plants which it equips has largely contributed to its success in the securing of valuable electrical contracts in Mexico, as well as in the Central and South Americas. The contract for the municipal plant for the City of Merida, capital of the State of Yucatan, was awarded to Siemens & Halske for much the same reason. The Merida plant will, it is estimated, cost fully $400,000. The existing arrangements, however, will not preclude substantial purchases from being made from time to time in the United States for mechanical and steam apparatus for use in the City of Mexico plant. It has been decided to do away with the smokestacks at present used in the generating station. Such alterations will mean an expenditure for new apparatus in the neighborhood of $50,000. Among the principal items which Mr. Barnes will see about while here are two induced draft fans for 7000 horse-power of boilers and some steam economizers. He will also decide as to the feasibility of adopting automatic stokers. Mr. Barnes' New York address is 56 West Thirty-sixth Street.

TRADE WITH JAPAN.—The four following items are of particular interest in that they show that American machinery and electrical apparatus are growing in favor in Japan.

THE VILTER MANUFACTURING COMPANY, MILWAUKEE, will supply a 20-ton ice-making plant for Kyoto, Japan. The Westinghouse Electric & Manufacturing Company will supply an electric equipment for the plant, which will receive power from the Biwa canal. The order was secured through the Japanese house of Takata & Co., whose New York offices are located at 10 Wall Street.

MACHINERY FOR JAPAN.—K. Oliva and S. A. Kamoto, of Tokyo, Japan, two gentlemen interested in a Japanese machinery syndicate, have been in Cincinnati, visiting the large electric manufacturing plants. They spent several days looking about, and were entertained at the plants of the Bullock Electric Manufacturing Company, in Norwood, Ohio, the Triumph Electric Company, and others. The gentlemen placed some good-sized orders.

THE NAGOYO ELECTRIC LIGHT COMPANY is to have an up-to-date American electric light plant. It is proposed to begin operations by using 5000 lights, but it is reported that the scope of the plant will be materially extended very shortly. The General Electric Company will supply a 300-kw generator, a 500-hp engine will be furnished by McIntosh & Seymour, of Auburn, N. Y., while the Babcock & Wilcox Company, of New York, is to ship two 250-hp, water-tube boilers. Altogether, some $60,000 is being expended in the initial equipment of the Japanese plant.

JAPANESE ELECTRIC RAILWAYS.—The Kyoto Electric Traction Company is about to extend its operations. The road, which is of American material and equipment, was built some 10 years ago. At present, power is derived from a canal specially constructed from Lake Biwa, situated about 14 miles from the Japanese city. A new steam plant will now be erected, the principal contracts for the equipment of same having just been awarded through Takata & Co., of 10 Wall Street, New York City. The Westinghouse Electric & Manufacturing Company, of Pittsburg, will furnish a 250-kw generator; the Edward P. Allis Company, of Milwaukee, is to supply a 400-hp, cross-compound horizontal engine; two water-tube boilers of 200-hp each are to be forwarded by the Heine Safety Boiler Company, of St. Louis; the Knowles Pump Works Company, of Warren, Mass., will ship two large feed pumps; the Goubert Manufacturing Company, of New York, is furnishing a Stratton Steam Separator; the Wheeler Condenser & Engineering Company, of New York, will send some heating apparatus, while the order for assorted piping, valves, etc., has been secured by the Crane Company, of Chicago. There are a number of miscellaneous orders which Messrs. Takata expect to be in a position to decide upon within the next few days.

TRADE WITH CHINA.—An interesting question arises in connection with the disturbed condition of affairs in China at the present time, and that is: What will be the effect on international commerce? Viewed from this standpoint, all commercial and industrial nations are deeply interested in the outcome of the trouble. It looks now as if the pacification of the country would be brought about by joint action of the Powers, in which case a much wider and more rapid opening up of China to the markets of the world will likely result than if China herself controlled the situation. The settlement of the troubles, however it may be accomplished, is sure to be followed in due time by a broader Chinese market for the product of civilized nations, and particularly those of the United States. The Chinese merchants have a favorable leaning toward goods of American manufacture, as was pointed out by the Chinese Ambassador, Wu Ting Fang, in a speech delivered before the recent convention in Boston, of the National Association of Manufacturers. In our last issue we gave some extracts from his remarks which are of particular interest at this time. Our exports to Asia and Oceanica during the fiscal year ending this month will exceed $100,000,000, which figure has never been reached in the history of our trade with those far-away lands. Eight years ago the total exports amounted to about one-fourth of this year's figures. Recent reports from the Imperial Maritime Customs Service of China show that the trade of that country with the United States developed very rapidly last year, and items have frequently appeared in these columns which point to the rapid development in our trade with China. While the state of affairs in that country just now is distressing and painful to all civilized countries, an unprecedented awakening in commerce and industry is sure to follow the establishment of an overpowering foreign influence in China's affairs. American manufacturers should take heed and get rid of the attack of "indigestion of prosperity" to which Senator Depew recently referred—if any are so afflicted—as America's opportunity is at hand.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York, for the week ended June 23: Antwerp—73 packages electrical material, $2,974. Barcelona—2 cases electrical material, $166. British Poss. in Africa—109 packages electrical material, $2,975. Bristol—13 electrical machines, $3,000. British West Indies—19 cases electrical material, $272. British Australia—99 packages electrical material, $4,187; 83 packages electrical machinery, $3,160. Brazil—15 cases electrical machinery, $2,357; 26 cases electrical material, $1,767. British Guiana—6 cases electrical material, $456. Chile—29 packages electrical material, $1,049. Central America—34 cases electrical material, $540. Cuba—17 boxes electrical goods, $590; 41 boxes electrical machinery, $1,625. Christiania—105 packages electric motors, $2,300. Dutch West Indies—1 package electrical material, $19. Glasgow—3 packages electrical machinery, $10,000. Hamburg—81 packages electrical material, $2,821; 7 cases electrical instruments, $10,100. Havre—2 cases electrical machinery, $215; 150 packages electrical material, $5,842; 1 electric motor, $500; 4 cases automobiles, $4,000. Hong Kong—10 packages electrical material, $291; 5 cases electrical machinery, $318. Liverpool—118 packages electrical machinery, $26,000; 33 packages electrical material, $1,356. Leeds—1 package electrical material, $125. London—121 packages electrical machinery, $9,253; 122 packages electrical material, $4,171. Mexico—51 packages electrical material, $812; 2 packages automobiles, $900. Newcastle—29 packages electrical machinery, $2,800; 2 cases electrical material, $115. Porto Rico—40 cases electrical machinery, $4,098. Peru—22 cases electrical material, $973. Rotterdam—6 packags electrical material, $174. Southampton—6 packages electrical material, $90. Stettin—57 cases electric fans, $2,193. St. Petersburg—1 case electrical machinery, $503; 1 package electrical material, $153. U. S. Colombia—6 packages electrical material, $193; 12 cases electrical machinery, $2,146. Venezuela—63 packages electrical material, $190.

Special Correspondence.

ENGLISH NOTES.

London Office, ELECTRICAL WORLD AND ENGINEER,
June 16, 1900.

PRINCE OF WALES AN AUTOMOBILIST.—The use of automobiles ought to receive a great impetus in this country, as the Prince of Wales has decided to patronize this type of vehicle. During this week, at the Ascot Royal Hunt Meeting, His Royal Highness appeared several times in his motor carriage, which attracted a great deal of attention. The vehicle which His Royal Highness affects at the present moment is of the Daimler type, built in this country, the frames and wheels of which, however, were made in France.

THE CENTRAL LONDON RAILWAY, which is rapidly approaching completion, will be formally opened by His Royal Highness the Prince of Wales on June 27. Trains have been successfully running over the line for some time in an experimental way, but have not been thrown open to the public, owing chiefly to the delays in the completion of the various stations and the erection of the necessary electric lifts. We understand, however that great progress has been made during the past few weeks, and it is hoped that by opening day everything will be in readiness.

AFTER HAVING BEEN for many years situated at 39 Victoria Street, Westminster, with stores at 133 Bermondsey Street, London, S. E., Messrs. Robert W. Blackwell & Company, Limited, have removed to more central and commodious offices at 59 City Road, London, E. C. Messrs. Blackwell & Company have felt that it was of growing importance to them to have all their offices and stores concentrated in one location, where they could also have the privilege of power for doing such work as is necessary. It was impossible to find such facilities in Westminster, and they have accordingly removed to the above address, where they are within a few minutes of the centre of the city, and where at the same time they have all the accommodation and power facilities they desire.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, London, has been for some time looking for a manager for its Falcon Works at Loughborough, to succeed Mr. C. E. Hodgkin, who retired a few months ago. After a great deal of investigation it has at last appointed Mr. E. A. Leeson to the position, and his wide experience of steam engine construction should make him a valuable manager for the Brush Company. Mr. Leeson has had a great deal of experience with Messrs. R & W. Hawthorn, of Newcastle-on-Tyne, and was later the works manager of Messrs. Hawthorn & Guppy, at Naples, and later of the branch works of Sir William Armstrong, Mitchell & Company, of Pozzuoli, Italy. Recently Mr. Leeson has filled the position of works engineer to Messrs. Hawthorn, Leslie & Company, of Newcastle-on-Tyne, so that he enters upon his new position with the best of experience, and the Brush Company is to be congratulated on its selection.

THE FORMAL OPENING of the works of the English Electrical Manufacturing Company took place at Preston, June 14, and was the occasion of a pleasant social gathering. A large number of influential guests had been invited, and a special dining car was provided from London on the morning of June 13. The comfort of the London guests was looked after by Messrs. Rutherford, Armstrong and Schultz. At the works, the guests were received by Mr. George Flett, Prof. S. H. Short, Mr. C. A. Boyd and Mr. C. A. Mott, and they were shown through the works by one or the other of the members of the staff. The factory, as has already been stated in these columns, is admirably adapted to its objects, the raw material or castings being received at one end of the building, which is almost 900 ft. long, and the finished motors and generators being shipped at the other end near the offices. In the evening a dinner was given to the guests by the directors at the Park Hotel, over which Mr. R. H. Prestwich, chairman of the company, presided. The opening ceremony occurred on the following day at noon. The engines were christened by Mrs. Prestwich, who broke over the frame of each a bottle of champagne, at the same time christening them Theodora and Irene, respectively, after her two daughters. The works were then formally opened, after which a lunch was served, at which the mayor of Preston, the Lord Provost of Edinburgh, Mr. E. W. Rice, Jr., of Schenectady, and Prof. S. P. Thompson, were present.

General News.

THE TELEPHONE.

CENTERVILLE, IA.—The Centerville Telephone Company has been organized. It has a capital of $25,000.

STERLING, KAN.—During a recent thunderstorm the telephone office here was struck by lightning and burned out.

NEVADA, MO.—The Missouri & Kansas Telephone Company, of Nevada, Mo., gave a mortgage for $1,250,000 to the Old Colony Trust Company last week.

LEWISBURG, OHIO.—The Lewisburg Telephone Company has been incorporated. Capital, $1,500. Incorporators: W. G. Brown, E. C. Priddy, D. E. Horn.

CAMDEN, OHIO.—The Camden Telephone Company, capitalized at $10,000, has been incorporated by C. F. Brooks, Jr., S. E. Morton, L. D. Lesh, Elam Fisher and Will W. Morrison.

DENVER, COLO.—At a meeting of stockholders of the Colorado Telephone Company, it was voted to increase the authorized capital stock of the company from $1,500,000 to $3,000,000.

MONTGOMERY, ALA.—The Montgomery City Council has ordered the telephone wires in Montgomery to be placed underground, the work to be accomplished by March of next year.

AKRON, OHIO.—The Summit Telephone Construction Company, Akron, capitalized at $5000, was incorporated by W. A. Green, L. S. Foltz, B. W. Green, G. A. Shaffer and T. W. Wakeman.

CHICAGO, ILL.—The Kraft Combination Telephone Company, Chicago, has been incorporated. Capital stock, $375,000. Incorporators: Charles H. Kraft, William L. Rohrer and I. M. Hamilton.

CRESCO, IA.—The Fremont Farmers' Telephone Company, of Cresco, has been incorporated with a capital of $432. Incorporators: W. G. Eddy, E. E. Eddy, both of Cresco; W. Kendall, of Kendalville.

HEDRICK, IA.—The Hedrick Telephone Company has been incorporated. Capital, $2,000. Incorporators: C. M. Speck, J. C. Burns, F. W. Ritter, L. L. Bowlin, W. D. Martin, H. E. Duke, all of Hedrick.

BRISTOL, VA.—The Briston Telephone Company has executed a mortgage to the International Trust Company, trustee, to secure an issue of $75,000 of 5 per cent bonds. The bonds have already been placed.

ROCHESTER, N. Y.—The striking Bell Telephone Company linemen have succeeded in making trouble for the company. The strikers recently cut off all the long-distance service from this city, except to Buffalo.

HALIFAX, N. S.—The Nova Scotia Telephone Company, of Halifax, N. S., has decided to make improvements to the system. These will include a new switchboard and a double metallic circuit throughout the city.

CORTLAND, N. Y.—The Cortland Home Telephone Company has been incorporated. Capital, $7,500. Directors: Charles D. Ver Nooy, Willard H. Jones, George J. Hager, William Martin and Herbert L. Smith.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has purchased the Peninsular Telephone system, comprising several exchanges and more than 100 miles of long-distance wires in the southern part of Michigan.

PIONEER, OHIO.—The Pioneer Telephone Company has been incorporated. Capital, $3,000. Incorporators: L. A. Beard, C. A. Kerr, W. F. Kessler, H. G. Young, F. J. Hadley, M. T. Hodson, A. E. Quidort, J. P. Hannan.

NEKOOSA, WIS.—The local telephone company is building a line to connect with its south branch at New Rome, Adams County, to Arkdale, which will give this place connections with Friendship, Necedah, New Lisbon, Manston and Portage.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company has purchased the lot located at the corner of Park Way and East Diamond Street, Allegheny City, for $25,000, and will immediately begin to erect the Allegheny Exchange on this place.

STEVENS POINT, WIS.—Articles of incorporation of the Almond Telephone Company have been filed here. The capital stock is $5,000. The incorporators are F. J. Frost, E. S. Cooper, J. A. Bowden, J. H. Johnson, W. C. Fisher, Stewart Hicks and David Hicks.

KOKOMO, IND.—The Central Union Telephone Company, which has had a monopoly in this city for years, has announced a cut of 50 per cent in rates in order to meet the rates of a new rival company starting with 400 contracts, leaving the old with less than a hundred.

BIRMINGHAM, ALA.—The People's Telephone Company, of Birmingham, Ala., has been organized, with a capital of $200,000, by Youngstown (Ohio) capitalists. The officers are H. H. Stambaugh, president; S. B. Claypool, secretary and manager; A. E. Adams, treasurer.

CLEVELAND, OHIO.—At the recent annual meeting of the Cleveland Telephone Company it was resolved that the directors increase the capital stock $1,000,000 for the purpose of establishing in this city four additional branch offices, and increasing the number of subscribers to 25,000.

WAUSAU, WIS.—The Marathon County Telephone Company was organized on June 20. The following board of directors was elected: W. F. Ladu, of Mosinee; A. W. Puchner, Athens; K. W. Dolge, Marshfield; F. A. Strupp, Athens; F. P. Stone, A. L. Kreuter and C. S. Gilbert, Wausau.

CALCUTTA, INDIA.—The Bengal Telephone Company, Limited, of Calcutta, has 600 subscribers. The capital is 880,000 rupees, divided into 8800 shares at Rs. 100 each. J. B. Saunders is general manager, and the directors are Hon. Allan Arthur Shirley Tremearne, Nolin Behary Svican and J. B. Saunders.

ALBANY,, N. Y.—The New Union Telephone Company has been incorporated to operate between Glens Falls, South Glens Falls, Sandy Hill, Fort Edward and the adjacent towns, and to Albany and Troy. Capital, $100,000. Directors: B. B. Fowler, L. M. Brown and Arnold Wurtenberg, of Glens Falls.

MEMPHIS, TENN.—The Dixie Telephone Company, of Benton County, with a capital stock of $1.500. has been chartered. The incorporators are J. F. Dowdy, W. A. Potts, W. P. McGill, W. T. Hubbs, J. F. McKelvey, John Rafford, W. H. Evans, Will N. Rushing, G. W. E. Hering, A. V. Bowles and R. G. Hudson.

MACKINAC ISLAND, MICH.—A telephone cable 3½ miles long, connecting the island of Mackinac with St. Ignace, was laid by the Michigan Telephone Company, which is part of the Erie system. The cable contains 10 copper metallic circuits. Several officers of the Erie Company were present, including President Glidden.

CHATTANOOGA, TENN.—The Interstate Telephone & Telegraph Company, organized to build and operate lines of telephones in Georgia, Tennessee and Alabama, has almost completed the first line from Scottsboro, Ala., to this city. Connection will be made here with the East Tennessee Company, and will run to a number of smaller towns in Georgia and Alabama.

DENISON, TEX.—The Jefferson Telephone Company has been incorporated in the Indian Territory to build a system of telephone lines in the Creek, Cherokee, Choctaw and Chickasaw nations and through the Seminole Nation. The company will pay the Indians a franchise royalty of $5 for every 10 miles constructed, and purposes to cover the five nations completely.

MT. VERNON, ILL.—The Southern Illinois Telephone Company, by order of the Circuit Court at Springfield, Ill., has been placed in the hands of Receiver B. G. Kemmell, of Effingham, Ill., on the petition of R. S. Winslow, on behalf of Monmouth College. The appointment grew out of an unsuccessful attempt to remove O. T. Kemmell, secretary and treasurer of the company. The company has officers throughout Southern Illinois.

ST. PAUL, MINN.—Twin-City (Minneapolis and St. Paul) capitalists signed a contract with Mr. Hubinger, owner of the Mississippi Valley Telephone Company, on June 15, whereby the former agree to put in $500,000 and take a proportional share of the stock. Mr. Hubinger has already spent $600,000 on equipment in St. Paul and Minneapolis, there being 1800 telephones in the latter city and about 1000 in the former in operation. As much more capital will be added as is necessary to make extensions and secure outside connections.

MINNEAPOLIS, MINN.—The annual stockholders' meeting of the Northwestern Telephone Exchange Company (Erie system) was held on June 20. The following board of directors was elected: Charles E. Adams Lowell; Frederick A. Farrar, Boston; Charles J. Glidden, Lowell; John E. Hudson, Boston; William J. Latta, Philadelphia; Martin Maloney, New York; Thomas Sherwin, Boston. The board of directors organized by electing Charles J. Glidden, president; Charles E. Adams, Heman J. Pettengill, vice-presidents; Charles P. Wainman, general manager; George B. Perham, secretary; Charles A. Grant, treasurer.

CLEVELAND, OHIO.—The annual meeting of the Cleveland Telephone Company was held last week. The following directors were re-elected: Charles E. Adams, Lowell; Charles J. Glidden, Lowell; Frank F. Hickox, Cleveland; Alfred B. Hough, Cleveland; John E. Hudson, Boston; Lee McBride, Cleveland; William J. McKinnie, Cleveland; James P. McKinstry, Cleveland; Thomas Sherwin, Boston; Edward P. Williams, Cleveland, and Edward P. Wright, Cleveland. Board of directors organized by the election of the following: President, Charles J. Glidden, Lowell; vice-presidents, J. P. McKinstry, Cleveland; Charles E. Adams, Lowell; treasurer, Charles A. Grant, Lowell; secretary, George B. Perham, Lowell.

ELECTRIC LIGHT AND POWER.

TAMPA, FLA.—The Tampa Electric Company has let the contract to have the old power house entirely remodeled.

KANSAS CITY, MO.—The Kansas City Electric Light Company let the contract for placing wires underground.

BOSTON, MASS.—The Needham Electric Company has been incorporated. Capital, $15,000. Incorporators: W. W. Carter, C. H. Carter, F. B. Carter.

ROCK HILL, S. C.—The contract for the dam of the Catawba Power Company at Rock Hill, S. C., has been let. The work will cost about $52,000 on the dam alone.

COLUMBIA, S. C.—The Columbia Electric Railway, Light & Power Company has purchased 12 new cars and is completing very extensive additions to its plant and electric railway.

PERU, IND.—An electric light wire crossed the fire-alarm system in this city on the night of June 14, burning out every box in the city. It will require two weeks to repair the damage.

CARTARET, N. J.—The Cartaret Electric Light & Power Company has been incorporated. Capital, $20,000. Incorporators: John A. Quin, Jr., Walter K. Whitaker, William J. Lansley.

HESPELER, ONT.—The council for this town has passed a by-law to raise $10,000 by debentures for the purpose of taking over the Shantz electric light plant in operation in that town.

RALEIGH, N. C.—The Caraleigh Cotton Mills at Raleigh, N. C., are enlarging their electric light plant and putting arc lights in the mill. A new engine has been installed in the power house.

MANNING, S. C.—The New Cotton Seed Oil Mill & Illuminating Company of this place has been chartered. Capital stock, $30,000. F. P. Ervin is manager and will purchase the machinery.

BRANTFORD, ONT.—The directors of the Brantford Electric & Operating Company, of Brantford, Ont., have decided to erect a new fireproof power house, the estimated cost of which is $30,000.

GREENSBORO, N. C.—The Guilford Power Company has been granted a franchise from the town of Greensboro. The matter is still open. The company proposes to install a modern street railway system.

OSGOOD, IND.—After a long agitation, the Town Board has decided to put in an electric light plant. James B. Nelson, of Indianapolis, will superintend the work, plans and specifications having been submitted.

TONAWANDA, N. Y.—The Tonawanda Lighting Company, of Tonawanda, has been incorporated. Capital, $100,000. Directors: N. B. Wickware, Akron; Frederick Wende, Buffalo; George P. Smith, North Tonawanda.

ROCK HILL, S. C.—The Water, Power & Electric Light Company of Rock Hill, S. C., has refused an offer of $15,000 from the town. The company proposes to put in a new system of arc lights and make other improvements.

NAPANEE, ONT.—The Standard Electric Light Company has been organized at Napanee, Ont., and has taken over the electric light and power business of Mr. J. R. Scott, of Napanee. It is understood that the extension of the plant is under consideration.

OAKLAND, CAL.—The city of Oakland, Cal., recently awarded the contract for lighting the streets and public places for the ensuing year to the Oakland Gas, Light & Heat Company. The company will give an increased number of electric arc lights for the same total amount that was paid by the city last year.

NAPANEE, ONT.—Messrs. Dean & Shibley, bankers, of Napanee, Ont., are negotiating for the purchase of the interests of the Trenton & Belleville Electric Water Power Company, the Belleville Gas Works and the Belleville Electric Street Railway. If secured, it is the intention to extend the railway and to make improvements to the lighting and power plants.

SAN FRANCISCO, CAL.—The McCloud River Electrical Power Company has been granted a franchise by the supervisors of Shasta County, Cal. The application was made in the name of Col. Park Henshaw, of Chico. The company expects to have the electric railroad in operation from Redding to the new mining town, Copper City, a distance of 30 miles, in one year.

HOUSTON, TEX.—The new municipal electric light plant for this city will have a capacity of 300 arc lights and 6000 incandescent lights. The bid of Mr. E. J. O'Beirne, of Birmingham, Ala., of $99,750, was accepted by the board of electric light commissioners of Houston for the complete mechanical electrical portions of the proposed plant. Mr. O'Beirne will use Western Electric Company apparatus in filling this contract.

BALTIMORE, MD.—The United Railways & Electric Company has decided to go ahead with the work on the new central power house on O'Donnell's wharf, and has secured a permit for the erection of the same. The cost of the building is placed at $200,000. It will adjoin the Pratt Street power house; will be three stories in height and will be 96 by 132 ft. On the top floor will be the coal bins. Three new engines will be erected and 16 batteries of two boilers each installed in the new building.

GALVESTON, TEX.—In the suit of the Massachusetts Loan & Trust Company vs. the Citizens' Electric & Power Company of Houston, Tex., the United States District Judge, June 15, issued an order postponing the sale of the plant of the company until the first Monday in October. The judge also ordered the receiver of the company to institute suit against the city on the common law docket for $34,344.04, alleged to be due the receiver for street lights, furnished the city by the receiver.

NEWARK, N. J.—The Central Electric Company has been incorporated and organized, Philip N. Jackson being elected as president. The other officers elected were: Vice-president, Adrian Riker; secretary, L. D. Howard Gilmour; treasurer, Uzal H. McCarter; directors, Philip N. Jackson, L. D. Howard Gilmour, Adrian Riker, Dudley Farrand, Uzal H. McCarter. The field of operations will be in Perth Amboy, New Brunswick, Metuchen, Rahway and other outlying towns and cities, the object being to gather in all the small electric light and power companies operating therein and bring them all under one management.

LITTLE FALLS, MINN.—The case of the Little Falls Electric Light & Water Company against the city of Little Falls, was decided in favor of the plaintiff. The company asked for an injunction against the city, which intended to establish a municipal lighting plant in spite of the fact that the City Council had granted to the company a franchise which had not yet expired. The court ruled that the contract between the city and company was binding and that the franchise was valid. A similar case is that of the city of Anoka, and the Anoka Electric Light & Power Company. The Anoka City Council has refused to pay for water and light used by the city, although still continuing to use the same. The case has not yet gone to the court.

ELKHART, IND.—On July 2, the Home Electric Light & Power Company will pass into the control of a corporation which proposes to invest several million dollars in the construction of dams and electric power plants at different points along the St. Joe River. Among the Eastern capitalists prominently interested in the enterprise are P. F. Thompson, C. H. Tenney, H. L. Crawford, H. H. Porter, Jr., Francis Blossom, of New York; M. E. Beiger, and John Sanders, of Mishawaka, Ind. It is stated that a large power house will be erected at South Bend, and that it is the intention to deliver in Elkhart sufficient power to run all the manufacturing establishments in that city, as well as supplying the residents with light and current for heating and cooking purposes.

MEMPHIS, TENN.—The Electric Light Company has been granted a 35-years' franchise by the Council committee in charge of the proposition, but on the following sweeping conditions: First, that granting the franchise does not prevent the city from building its own plant; second, that it does not prevent the city from extending a like franchise to any other company desiring to operate here; third, that the company shall build the city's part of the manholes in the conduit system, the city's pro rated share being estimated to cost $8,000; fourth, that all the city lighting be done at a rate of 10 cents and arc lights at $85 a year, and finally, that the company replace all lamps and accept a sliding scale of 44 cents for the first five years, 13½ cents for the next 10 years, 12½ cents for the following 10 years and 12 cents for the last 10 years. This is the rate to be charged consumers.

THE ELECTRIC RAILWAY.

MUNCIE, IND.—The Union Traction Company, of this city, has issued orders that all employees must be vaccinated.

SALISBURY, N. C.—The Salisbury Street Railway Company did not obtain a charter which was asked from the State Legislature.

BOSTON, MASS.—It is expected that the overhead division of the Boston Elevated Railway Company will be in operation by Jan. 1 next.

NEW CASTLE, DEL.—Extension of the New Castle & Deleware City Electric Railway to points down the Eastern shore is now being talked of. It will require $60,000 to extend the road.

ATLANTA, GA.—The Atlanta Rapid Transit Company has filed a petition with Fulton County commissioners of roads and revenues to extend its Juniper Street line to Piedmont Park.

SAGINAW, MICH.—The Saginaw Suburban Electric Railway has asked the Common Council for a franchise through the streets of Saginaw for its line which is to run from Bay City to Flint.

CHICAGO, ILL.—Judge Kohlsaat has appointed Charles Henrotin receiver of the Chicago Electric Traction Company, which operates cars between Englewood and Blue Island. Mr. Henrotin has filed a $25,000 bond.

FINDLAY, OHIO.—A contract has been entered into by Theodore Wentz, president of the Findlay, Fostoria & Toledo Electric Railroad, for the construction of the road between this point and Fostoria by Oct. 1.

SLATEDALE, PA.—The Slatedale Street Railway Company has been incorporated. Capital, $50,000. Incorporators: F. J. Crilly, J. L. Schwartz, P. F. Cannon, F. A. Kreitz, W. J. Saeger, all of Allentown, Pa.

ELKHART, IND.—Niles and Berrien Springs will be connected with this

city, and Goshen, Mishawaka and South Bend by a branch of the Indiana Railway Company, which now runs between Goshen and South Bend.

WEYAUWEGA, WIS.—The Hutchinson Electric Railway Company is a new corporation for this city. Power is to be furnished by the Ostrander dams, where immense turbines will be placed. The company is now asking for franchises.

AKRON, OHIO.—Employees of the Akron, Cuyahoga Falls & Barberton Rapid Transit Company, who demanded a raise of 20 per cent in wages, agreed to accept the company's offer of a 10 per cent increase for both day and night men.

DALLAS, TEX.—The Dallas, Fort Worth & Southern Electric Railway Company has been incorporated. Capital, $1,000,000. Incorporators: George T. Bishop, J. B. Coffinberry, George F. McKay, M. G. Watterson, all of Cleveland, Ohio.

CINCINNATI, OHIO.—The extension and improvements of the Mill Creek Valley Street Railway line from Cincinnati to Hamilton, Ohio, was commenced on June 25. Contracts for the new material have been let mainly to Cincinnati concerns.

PORTLAND, ME.—Manager Newman has announced that the employees of the Portland Street Railroad Company, which controls all city and suburban lines except the road running to Yarmouth, had been granted an advance of 10 per cent in wages.

ROCHESTER, N. Y.—The Rochester Railway Company has elected these dierctors: T. J. Nicholl, S. Stace, C. S. Baker, F. Cook, J. N. Beckley, E. H. Satterlee, G. W. Archer, C. F. Pond, C. C. Woodworth, J. Gerling, W. C. Barry, George G. Moorehouse and H. P. Brewster.

ROME, GA.—The negroes of Rome have declared an absolute boycott on the Rome street railway. The boycott is the result of a rule restricting them to the three rear seats, which they bitterly resented. All the colored minsters in the city have advised their flocks to quit riding on the cars altogether.

RUSHVILLE, IND.—The leading business men of this city have organized the Rushville & Brookville Traction Company, the purpose being to construct an electric line from this city to Brookville, via Salem and Andersonville. The line will form a connecting link between Cincinnati and Indianapolis. Capital stock, $50,000.

OKLAHOMA CITY, OKLA.—The Oklahoma Land & Electric Street Railway Company has been organized in this city and capitalized at $200,000. The officers are: Judge J. M. Lindsay, of Gainesville, Tex., president; S. E. Laird, vice-president; G. B. Stone, secretary and treasurer; George C. Kelly, of Birmingham, Ala., general manager, and J. H. Everest, attorney.

PITTSBURG, PA.—The American Electrical Works, Providence, R. I., have received a contract from the Consolidated Traction Company of this city for 42 miles of wire, and the Birmingham Traction Company has also contracted with the American Electrical Works for a large amount of copper wire, some of this being feed wire and some bare copper wire to be used as rail bonds.

NEW YORK, N. Y.—The authorities of the village of Bronxville have finally agreed to give the New York, Westchester & Connecticut Traction Company a franchise which will enable it to extend its Mt. Vernon line to Tuckahoe and Scarsdale. In its new franchise the company agrees to pay 1 per cent of the gross receipts after 25 years and to sprinkle the highways in the summer months.

APPLETON, WIS.—On June 16 the main power house of the Fox River Valley Electric Railway was totally destroyed by fire, and crippled the system until a temporary plant could be arranged. This temporary plant was sufficient to supply power to cars on the line between this city and Neenah. On June 21 lightning burned out this temporary plant, which tied-up the entire system until further arrangements could be made.

COLUMBUS, OHIO.—The consolidation of Northern Ohio electric railway interests was recorded in the office of the Secretary of State on June 20, the Cleveland, Elyria & Western Railway Company being formed by the consolidation of the Cleveland, Berea, Elyria & Oberlin Railway Company, the Lorani County Railway Company and the Oberlin & Wellington Railway Company. The capital stock of the combined company is fixed at $2,000,000.

HOLLAND, MICH.—The Holland & Lake Michigan Electric Railway, including the entire equipment, has passed into the hands of Grand Rapids, Holland & Lake Michigan Rapid Railway Company, of Grand Rapids. The officers of the new company are: President, John Winter; vice-president, B. S. Hanchett, Jr.; secretary, O. H. Lau; treasurer, Frank C. Andrews. All live in Detroit except Hanchett, who is a Grand Rapids man.

NEW YORK, N. Y.—The application made by former Senator P. H. McNulty for an injunction restraining the Brooklyn Heights Railroad Company from charging 10 cents fare to Coney Island was denied by Supreme Court Justice Dickey, because "the plaintiff cannot maintain this action in behalf of the whole people where the injury to him is in common with others, he not being distinguished from others by being specially damaged in a way not common to them."

PLAINFIELD, N. J.—The Riker-Hine trolley syndicate, which is building the cross-county trolley from Westfield to Rahway, is stalled in its work at Picton. The trolley promoters do not want to build an overhead bridge to cross the tracks of the Lehigh Valley Railroad Company, and the latter refuse to permit the trolley company to cross at grade. The work on the trolley line at that point has been stopped in the hope that some terms can be made with the Lehigh, but the officials say they will not permit a grade crossing under any circumstances.

RICHMOND, VA.—The lines of the Richmond & Manchester Railway Company have been placed in the hands of a receiver. The motion was made before Judge Waddill by Messrs. Meredith & Cocke and Wyndham R. Meredith, who represented $392,000 of the $400,000 of bonds issued, and who applied for the receiver on the ground that the Richmond & Manchester Railway Company, having transferred its rights in the road to the Richmond Passenger & Power Company was not in a position fulfil its obligations to the bondholders of the road. Judge Waddill appointed as receiver Major Beverley R. Selden.

NEW YORK, N. Y.—By July 15 it is expected the entire system of elevated railroads in Brooklyn will be operated by electricity. The work of laying the third rail on all the divisions of the Lexington Avenue and Myrtle Avenue lines is now nearing completion. The work on the four loops at East New York, costing $100,000, and connecting the Lexington Avenue and Kings County lines at Vesta Avenue, is nearly finished, and a continuous service will be introduced, which will allow the passengers of one line to change to the other line, if necessary, to reach their destinations. Trains running from the Fulton Ferry, after making the loop, will run to the Broadway Ferry in the Eastern District and return.

PITTSBURG, PA.—At an adjourned meeting of the stockholders of the Consolidated Traction Company on June 20, for the purpose of ratifying the proposition of the board of directors to lease the lines to the Union Traction Company, the same opposition which manifested itself at a previous meeting was again in evidence, but in spite of this the deal went through by a vote of 432,473 shares to 20,610. Then an election of a board of directors took place, with the following result: C. L. Magee, Joshua Rhodes, B. F. Jones, T. H. Given and John A. Bell. Although the opposition has threatened to fight the deal in the courts, it is not expected that this threat will be carried out, and it will not be very long now until the Union Traction Company will have absorbed all the local traction companies.

CHICAGO, ILL.—Articles of incorporation of the St. Louis & Illinois Electric Railway Company were filed. The object of the new company is to construct an electric road from East St. Louis to Edwardsville, in Madison County, by way of Collinsville, with a branch line from East St. Louis to Alton, by way of Madison, Venice, Granite City and Horseshoe Lake; also a branch from Collinsville to Highland, in Madison County, via Troy and St. Jacob; also a branch from Collinsville to Belleville; also a branch from Venice to Edwardsville and Highland, via Glen Carbon, and also a branch from Collinsville to Lebanon. The incorporators and first board of directors are Ferdinand Vorwald, C. N. Travous, W. M. Warnock and George D. Buroughs, of Edwardsville, Ill., and Fred Kohl, Theodore F. Meyer and A. H. Smith, of St. Louis, Mo. The capital stock is $2,500,000, and the principal office is to be located at Edwardsville.

THE AUTOMOBILE.

THE ALTHA AUTOMOBILE & POWER COMPANY has been incorporated at Dover, Del., to manufacture and deal in electric vehicles. The capital stock is $500,000.

THE KENSINGTON AUTOMOBILE MANUFACTURING COMPANY, of Buffalo, has been incorporated, with a capital of $60,000. The directors are William J. Knowles, Charles G. Shepard, John J. Gibson, Horace C. Martin, James A. Roberts, Herbert P. Bissell, George C. Riley, of Buffalo.

THE NATIONAL AUTOMOBILE & ELECTRIC COMPANY'S plant, at Twenty-second Street and the Belt Road, Indianapolis, Ind., has started work. The company has operated a pattern shop for some time, and parts of automobiles and electric and gasolene engines have been made extensively. The company expects to turn out at least 10 completed vehicles each week.

AUTOMOBILES IN ST. LOUIS.—An automobile company, with headquarters in New York, is arranging through a representative, Mr. Charles Decker, to place 500 automobiles on St. Louis streets. Offices have been opened there to take subscriptions toward the formation of a local company. Operations will begin as soon as the first vehicles arrive. The capacity of the vehicles will be 30 passengers. They will be built so as to run on the tracks of the street car companies. Each vehicle will cost $2,000. The company will be incorporated and if objections are raised to operating the vehicles on the street, they will be sold to individuals.

NEW INDUSTRIAL COMPANIES.

THE FERRIS ELECTRIC COMPANY, of Farmington, Ill., has been chartered. Capital, $10,000. Incorporators: W. J. Ferris, J. Scribner, T. Ferris, all of Farmington.

THE INDEPENDENT TELEPHONE SUPPLY COMPANY, of Chicago, has been incorporated. Capital stock, $2,500. Incorporators: F. B. Macomber, G. S. Whyte and A. F. Coles.

THE PYRO ELECTRIC COMPANY has been organized in New York to manufacture electric machinery. Capital, $500,000. Incorporators: W. E. Gilmore, of Orange; E. L. Brown, G. G. Kolff, both of New York; H. Bull, attorney, New York City.

THE ELECTRIC SECURITY & SIGNAL COMPANY, of Chicago, has been incorporated to manufacture and deal in electrical appliances. Incorporators: A. F. Dooddridge, M. M. Murray, R. E. Richardson, S. B. Cheever, L. R. Curry, all of Chicago, Ill. Capital, $1,000,000.

THE UNITED STATES BATTERY COMPANY, of Jersey City, has been incorporated. Capital, $500,000. Incorporators: A. W. Stringham, F. Miller, both of Brooklyn; P. A. Holm, of Hoboken; A. C. Fern, O. T. Bugg, both of New York; L. H. Andrews, attorney, New York.

PITTSBURG, PA.—The Pittsburg Electrical & Machine Works have been incorporated in this city by the following-named gentlemen: Charles Schuster, Christian N. Begaman, Herman C. Haslage, Frederick Martzolf and John M. Goehring, all of Allegheny City. The capital stock of the company is $60,000.

PERSONAL.

MR. WILLIAM MARCONI, who came to this country a month ago on a short visit, sailed on the Teutonic for Liverpool on Wednesday of last week. Mr. Marconi spent much of his time in Ottawa, Canada. It is stated that he expects to return to this country within six months.

MR. C. J. B. WALL, of Perth, West Australia, who has installed a number of

important electrical plants in various parts of Australia, is visiting the United States for the purpose of arranging for the supply of some machinery for plants his firm—Splatt, Wall & Company—will soon erect in the gold regions of West Australia. Mr. Wall, who is a member of the British Institution of Electrical Engineers, recently installed a central station plant at Boulder, the chief town of the gold-mining district.

HOMEWARD BOUND.—The tide of European travel is already at its full and has begun to turn. The American liner St. Paul, arriving at New York on June 23, brought a large electrical contingent. It included Mr. A. R. Brewer, secretary of the Western Union Telegraph Company, and his family, who have been making a trip through Central Europe; and Mr. W. J. Johnston, who took in Paris as a pousse café to his little junket around the world. There were also Mr. C. J. Field, who has been carrying through some important automobile deals; and with him Mr. T. F. Flinn late of the Worthington Pump Company. Other members of the contingent were Mr. H. Durant Cheever, of the Okonite Company, and his wife; Mr. Charles E. Knox, electrical engineer, and his wife, and Mr. T. C. Martin and family.

Trade Notes.

OIL FILTERS FOR CUBA.—Among the orders for American goods which are coming in from new enterprises in Cuba is an order for Cross oil filters to equip a large, new electrical power house in Havana.

TO MANUFACTURE ELECTRIC LIGHT GLOBES.—A. Clarksburg (W. Va.) despatch states that the Pittsburg Glass Company is arranging to build a plant in that place for the manufacture of electric light globes on a large scale.

MR. C. J. HARRINGTON, manager sales department of the General Equipment Company, Camden, N. J., manufacturer of circuit breakers, etc., has just returned from an extended and successful trip through Northern New York and Western Pennsylvania.

THE WRIGHT DISCOUNT METER.—The General Incandescent Arc Light Company, New York, in bulletin No. 93, describes the construction and use of the Wright discount meter. The apparatus is clearly illustrated, and the principle of its operation shown.

HYDRAULIC PUMP CATALOGUE No. 56, of the Watson-Stillman Company, New York, contains many illustrations of hydraulic pumps and tools. These pumps and tools, which are used for a great variety of purposes, are briefly outlined in connection with the illustrations.

CENTURY AUTOMOBILES.—The Century Motor Vehicle Company, Syracuse, N. Y., manufactures electric, steam and gasolene automobiles, all of which classes of vehicles are illustrated in a 24-page pamphlet just issued by the company. The illustrations are accompanied by specifications.

THE JOHN H. McGOWAN COMPANY, Cincinnati, Ohio, is naturally pleased with the prevailing business situation, its shops being full of work and orders on hand that will require more than two months to fill. It has been obliged to put in new machinery, one addition being a 16-ft. planer.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, Hartford, Conn., announces that on and after July 1, 1900, Mr. J. E. Way will handle the Perkins Electric Switch Manufacturing Company's line in connection with the R. Thomas & Sons Company, at 39 Cortlandt Street, New York.

THE VAN ELECTRIC MANUFACTURING COMPANY, of Portland, Me., has been incorporated with a capital of $600,000. Incorporators: S. F. Van Choate, of Boston; W. E. Sanford, of Attleboro; C. Poole, of Rockland; J. E. Lewis, of Everett; F. A. Turner, of Foxboro, Mass.; F. Hale, attorney, Portland.

ELECTRIC-CONTROLLING DEVICES.—The Chicago Rheostat Company, 397 East Thirty-third Street, New York, in bulletins Nos. 40 and 41, illustrates and gives a good deal of information on the subject of its electric-controlling devices. A code is given to facilitate orders by telegraph of rheostats of any size and style.

ELECTRIC HEATING.—The McCay Engineering Company, 107 German Street, Baltimore, Md., has issued a pamphlet illustrating and describing a line of electric heating apparatus, consisting of irons, radiators, etc. The final section of the catalogue is devoted to illustrations of a number of switchboards installed by the McCay Company.

THE TUCKER MANUFACTURING COMPANY, York, Pa., has recently received an order from the United States Government for telephones, and also one from the Hawaiian Electric Company, of Honolulu. The company is increasing its capacity by the addition of another story to its building, and expects to have the same completed by July 1.

PNEUMATIC TOOLS.—The Standard Pneumatic Tool Company, Chicago and New York, has isued a 64-page pamphlet briefly describing and completely illustrating the extensive line of pneumatic tools and appliances manufactured by this company. Various illustrations show the applications of these tools. This pamphlet is a special edition for the Paris Exposition.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, reports business for the past year so far exceptionally good, almost double that of last. The company has sold an unusually large number of small machines throughout the United States. In the foreign trade two machines have been shipped recently to Havana, another one to a South American country and another to Russia.

BELT-TYPE MOTORS.—The Crocker-Wheeler Company, Ampere, N. J., in bulletin No. 11, recently issued, describes and illustrates small bipolar, belt-type motors manufactured by this company. The illustrations include diagrams of the trapezoidal slot armature which is used on these machines; also of the connections. General dimensions of the motors and speed rating, etc., are given; also a telegraph code.

MACHINE TOOLS.—The Hilles & Jones Company, Wilmington, Del., has issued a very elaborately illustrated catalogue of machine tools, designed and constructed by it. The catalogue contains a great many ilustrations of standard machines, each being accompanied by a brief description. It contains 176 pages of heavy-coated paper and is substantially bound in cloth.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., in a neat catalogue, describes and illustrates the latest forms of Viaduct apparatus, including district messenger call boxes, and various forms of telephone sets, including police, fire-alarm and telephone sets. Some space is also given to lightning arresters, telephone switches, generators, switchboard magnetic testing and other details.

ELEVATOR CONTROLLERS.—The Cutler-Hammer Manufacturing Company. Milwaukee, Wis., reports that it is receiving a large number of orders for its reversible elevator controllers and self-starters for operating electric elevators, motor-driven pumps, and for use in all cases where it is necessary to start a motor automatically. These devices are claimed to be absolutely reliable and are guaranteed to give satisfaction.

THE ARNOLD SYSTEM OF POWER STATION CONSTRUCTION.—The Arnold Electric Power Station Company, Marquette Building, Chicago, has printed in pamphlet form an address delivered by Mr. B. J. Arnold before the Chicago Electrical Association, on the "Arnold System of Power Construction." The pamphlet is very thoroughly illustrated, containing no less than 38 cuts, which together elucidate every detail of the Arnold system.

TELEPHONE INFORMATION.—Part 4 has been issued of the Ericsson Series, consisting of telephone information of a technical and general character. This instructive series is issued at regular intervals, in convenient form for reference and future use. The present issue contains a diagram and description of a metallic switchboard circuit, and some interesting information concerning the present state of telephony in a number of countries throughout the world.

GEORGE WILLIAM HOFFMAN, of Indianapolis, is still bending all his energies toward brightening the dynamo and engine rooms of electric light and street railway plants throughout the country by making a metal polish which has entered into universal use. Mr. Hoffman is offering to send a sample box of U. S. metal polish to any one who applies for it. He states that wherever he has been able to get the engineer in charge of a plant to try it, the result has invariably been a steady customer.

EMERSON FAN MOTORS.—Fan motors and ceiling fans for alternating current, manufactured by the Emerson Electric Manufacturing Company, St. Louis, Mo., are described as to their mechanical and electrical features, and illustrated in a 56-page pamphlet just issued by that company. Dimensions and other data of the various sizes of each type are given, together with considerable other pertinent information. The illustrations are very clearly executed and show the machines complete, and the various parts of the same. The company has an Eastern branch office at 136 Liberty Street, New York City.

"WOOD" SYSTEMS OF LIGHT AND POWER.—The Fort Wayne Electric Works, Fort Wayne, Ind., have just issued a pamphlet and a bulletin relating to the Wood systems of light and power. The former contains numerous illustrations relating to the Wood direct and alternating-current lighting systems, Wood lamps, switchboards, etc. An interesting illustration compares Wood dynamos as built in 1879, 1894 and 1898. The bulletin describes the "B and B" commutator trueing device, which may be very simply applied to turn down in place any commutator from 4 to 20 ins. in diameter, or from 6 to 36 ins. in diameter.

THE GENERAL POWER COMPANY, 100 William Street, New York, has issued a 16-page pamphlet, describing the Secor system of generating power for all purposes. The Secor oil motor is of the internal combustion type, and is claimed to possess points of superiority. The Secor oil electric-generator consists of a single Secor motor directly coupled to a dynamo by a rigid coupling or a continuous shaft. This machine is recommended for isolated electric plants of moderate size, for public or private use. The fuel consumption of these machines is one gallon per horse-power for one day of 10 hours at maximum load, which is equal to illuminating gas at 50 cents per 1000 ft.

ELECTRIC CAR HEATERS.—The contract for all of the electric heaters to be used on the Boston Elevated Railway Company has just been awarded to the Gold Car Heating Company, of New York City. This is one of the largest orders for electric heaters that has ever been placed, and includes in addition to the Elevated equipment an order for 150 sets of street car heaters. The Elevated cars are to be fitted with the Gold Standard electric heaters and the street cars will be equipped with the Gold Panel electric heaters. Before awarding this contract the Boston Elevated Railway officials made very extensive tests of the electric heaters furnished by five different car-heating companies, so that their decision in favor of the Gold heater means a great deal for that company.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces that it has decided to stop the manufacture of knife switches, switchboards and tablet boards, and has sold its switch and switchboard department to the Frank Adam Electric Company, 904 Pine Street, St. Louis, which will continue to manufacture the devices mentioned. The transfer of this department of the Emerson Company's business was made in order that the company might have its entire factory capacity and its undivided attention for the manufacture of its electric motors, for which there is a constantly increasing demand. The Emerson Company will henceforth devote its entire energies and capacity to the making of motors.

"SUBURBAN HOMES NORTH OF THE HARLEM."—The above is the title of a 48-page folder just issued by the passenger department of the New York Central, for the information and service of those seeking permanent or temporary homes in the suburbs of the metropolis. This folder contains a carefully prepared paragraph concerning each station in the suburban district north of the Harlem River, on the Hudson River Division, Harlem Division and Putnam Division, giving the distances, number of trains, fares and other information about the service. The admirable map in this folder enables home-seekers to utilize time and travel effectively in prospecting. A copy of "Suburban Homes North of the Harlem" will be sent free, postpaid to any address, upon receipt of a one-cent stamp, by George H. Daniels, General Passenger Agent, New York.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, Cleveland, O., was organized about a year ago for the purpose of promoting, building and maintaining telephone plants, and has since done a large amount of this class of work throughout the United States. It has recently added a manufacturing branch to its other line of telephone work, and is now ready to place on the

market telephone apparatus and devices that are up to date in their every particular. The practical men of this company have grown up in the trade since its infancy, and their connections with other telephone manufacturers, and practical experience in constructing and maintaining telephone exchanges give the company great advantages that will be of vast benefit in the development of its new work. The company, it is stated, has strong financial backing, and its purpose is to make the highest class of apparatus, trusting to the shrewdness of the exchange owner to accept it at a fair price. Mr. Burt Hubbell is president of this company, and will have direct charge of the business. C. B. Stowe is vice-president, and J. H. Fuller, secretary. Both of these gentlemen are prominent in business and financial circles in Cleveland. W. W. Kidney, until recently superintendent of the Hipwell Manufacturing Company's plant, is superintendent of the company. Particular attention will be given to the development of exchange apparatus, and a specialty will be made of the installation of intercommunicating and hotel systems. The work of promoting and constructing telephone plants will go on as heretofore.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JUNE 19, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

651,849. ELECTROLYTIC APPARATUS; M. Haas, Aue, Germany. App. filed May 26, 1899. The electrodes stand across the tank in the form of partitions, and are provided with openings alternately arranged in the middle and at the sides so that the liquid in circulating through them will be whirled and well mixed.

651,866. INCANDESCENT LAMP; I. Kitsee, Philadelphia, Pa. App. filed March 22, 1900. As an accessory, for an incandescent lamp, the pencil of which is non-conducting at low, but conducting at high temperatures, a conducting film consisting of finely divided platinum.

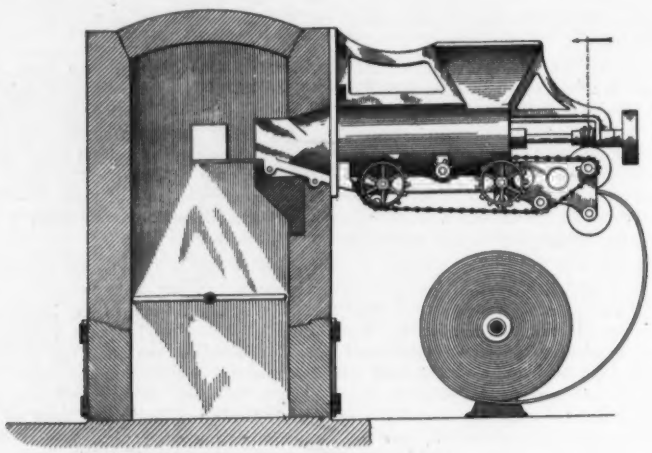
651,909. ELECTRIC MOTOR; H. O. White, Boston, Mass. App. filed Oct. 18, 1899. The motor is mounted on the same base with the machine to be driven, and the invention consists in the means for aligning the shafts and connecting them together.

651,916. FURNACE FOR PRODUCING CALCIUM CARBID; J. Zimmermann and I. S. Prenner, Chicago, Ill. App. filed June 8, 1899. For continuously feeding a supply of lime and carbon to the arc space of the furnace, a strip of stiff paper on which the material is carried, is constantly fed toward the arc space.

651,936. INDICATING KEY FOR SELECTIVE SIGNALS; C. E. Scribner and F. R. McBerty, Chicago, Ill. App. filed July 25, 1898. The combination with several individual keys and an indicator capable of assuming two positions associated with each key, of a mechanical device for each key actuated in the movement thereof adapted to impart movement to the corresponding indicator, intermediate mechanism between the mechanical device and indicator adapted to alter the relation between said device and indicator, and means for actuating the intermediate mechanism.

651,945. ELECTRIC MOTOR; C. L. Bundy, Philadelphia, Pa. App. filed June 6, 1898. Structural details.

651,978. ELECTRIC BELT; W. C. Sedwick, Des Moines, Ia. App. filed April 5, 1899. Details of construction.



651,916.—Furnace for Producing Calcium Carbid.

651,985. ELECTRIC ARC LAMP; A. B. Walton, Loraine, Ohio. App. filed Dec. 21, 1899. In this lamp two magnets are used, one being stationary and the other pivoted, the latter serving as the armature of the former, they being connected in separate circuits, one of which includes the arc.

652,003. ELECTRIC RAILWAY; W. Kingsland, London, England. App. filed Sept. 8, 1899. Details.

652,013. ANNUNCIATOR; C. E. Beach, Binghamton, N. Y. App. filed Jan. 2, 1897. Details.

652,027. TRANSFORMER; S. E. Johannesen, St. Louis, Mo. App. filed Feb. 14, 1900. In large transformers the coils are set vertically and are supported at the top and bottom by separate supports, which are adjustable. Another feature of the invention relates to the insulation of the coils and the means for protecting the same.

652,039. TROLLEY; G. W. Perry, Peoria, Ill. App. filed Feb. 6, 1900. Tapered fingers are arranged above the wheel to guide the wire to the wheel and at the same time prevent it from leaving the wheel when once seated.

652,116. RHEOSTAT; T. F. Jordan, New York, N. Y. App. filed March 20, 1900. The rheostat consists of a number of resistance coils arranged in pairs with connecting plates connecting the coils of each pair and contact plates connecting the successive pairs; a switch block, a conducting bar and means for guiding the block along the bar for the purpose of making contact with the plate, are also provided.

652,124. CONTROLLING ELECTRIC MOTORS AND APPARATUS THEREFOR; Henry Leitner, of London, England. App. filed July 10, 1899. The main automobile battery is divided into two parts, and a smaller battery for field excitation similarly divided into two parts. By means of an appropriate controller, the small exciter battery may be transferred to or from the main circuit, thereby giving certain intermediate speeds. The exciter battery serves to choke off any sudden rush of current to the armature in starting or increasing the voltage, and prevents reversal of field.

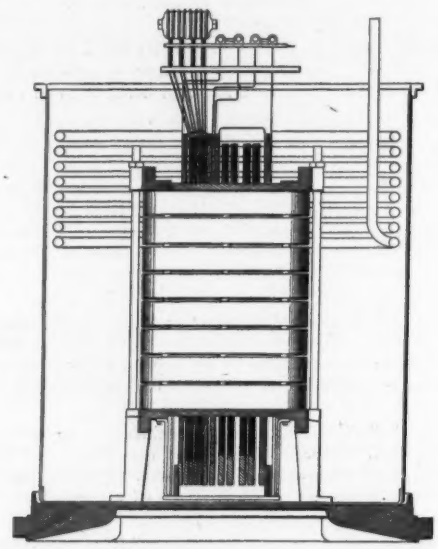
652,151. AUTOMATIC ELECTRIC SWITCH; P. S. Tirrill, Groveton, N. H. App. filed Sept. 23, 1899. Details.

652,187. SYSTEM OF ELECTRICAL DISTRIBUTION; S. Krohn, Berlin, Germany. App. filed Nov. 2, 1899. (See Current News and Notes.)

652,194. ELECTRICAL INCANDESCENT LAMPS; M. von Reckinghausen and M. Vogt, London, England. App. filed Nov. 6, 1899. According to this invention, which relates to the Nernst lamp, it is insured that the heater shall always be below the lamp conductor, whether the lamp be set vertically or horizontally, by suspending the heating coil at its ends from pivots in a line with the axis of the lamp conductor, so that the heating coil can swing freely upon the pivot and always hang below the conductor.

652,214. APPARATUS FOR MEASURING CONSUMPTION OF ELECTRIC CURRENTS; C. R. Louberry, Paris, France. App. filed Feb. 17, 1899. The combination, with a main supply circuit, of means for measuring the consumption of electric current supplied thereby, said means comprising an auxiliary circuit, means in said auxiliary circuit for causing interruptions in the circuit carried thereby, a registering device and continuously-driven actuating means therefor, said device being normally held out of engagement with its actuating means, and an electromagnetic device in the auxiliary circuit adapted upon each interruption of the current on said circuit to attract the registering device and hold it for a predetermined period in engagement with its actuating means.

652,217. ELECTRIC BELT; M. A. McLaughlin, Los Angeles, Cal. App. filed Dec. 27, 1898. Improvement in details.



652,027.—Transformer.

652,229. RECEPTION AND TRANSLATION OR TRANSMISSION OF TELEGRAPHIC SIGNALS; A. Muirhead, London, England. App. filed March 16, 1900. A relaying arrangement consisting of a submarine telegraphic cable system, a receiver coil, a contact tongue attached thereto, a body with contact surfaces thereon in the same plane, over or across which the tongue oscillates, forming part of a transmitting circuit, means serving to curb the movements of the receiver coil and means for moving such body in the plane of its contact faces and to and from the centre of motion of the coil; all for the purpose of improving the character of the retransmitted signals.

652,230. ART OF REDUCING ATTENUATION OF ELECTRICAL WAVES AND APPARATUS THEREFOR; M. I. Pupin, Yonkers, N. Y. App. filed Dec. 14, 1899. (See page 986.)

652,231.—ART OF REDUCING ATTENUATION OF ELECTRICAL WAVES; M. I. Pupin, Yonkers, N. Y. App. filed May 28, 1900. (See page 986.)

652,084. HOTEL ANNUNCIATOR SYSTEM; Clayton B. Clark. App. filed June 20, 1899. The invention consists in so arranging and combining a central telephone and a series of telephones with an annunciator system that the central telephone, when placed in circuit with one of the series, offers a resistance to the current sufficiently great to reduce the strength of the current to a degree that will prevent an alarm being sounded, but not to such an extent as will prevent the indicator dropping.

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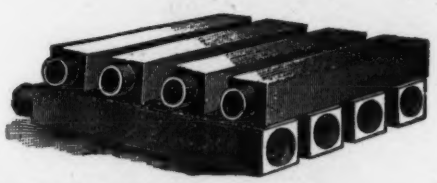

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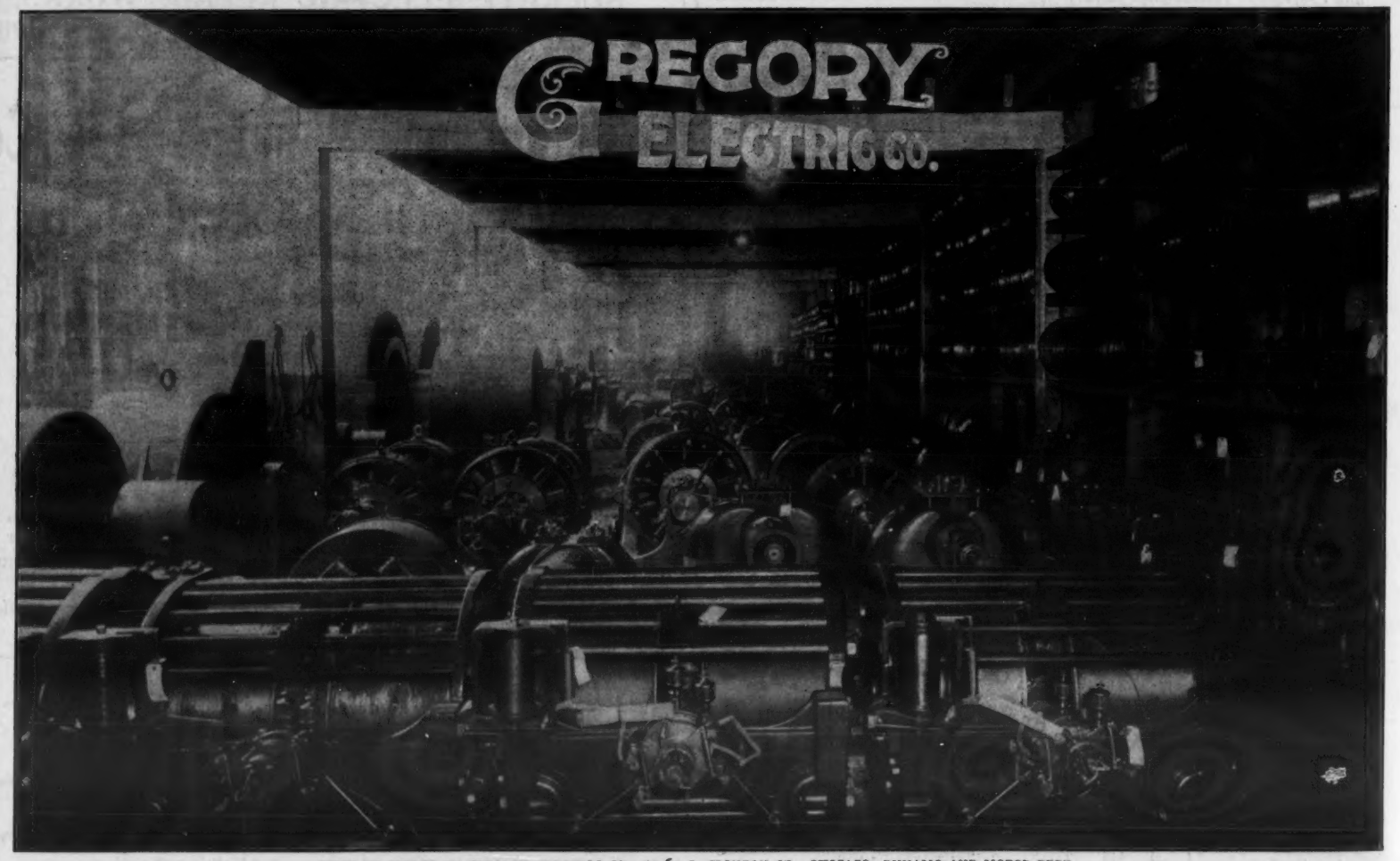

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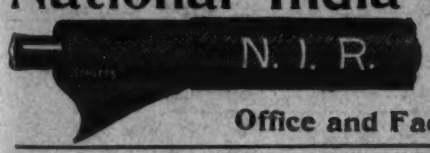

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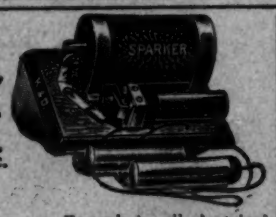

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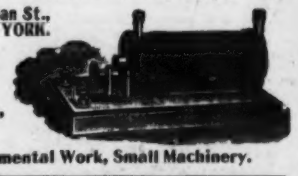
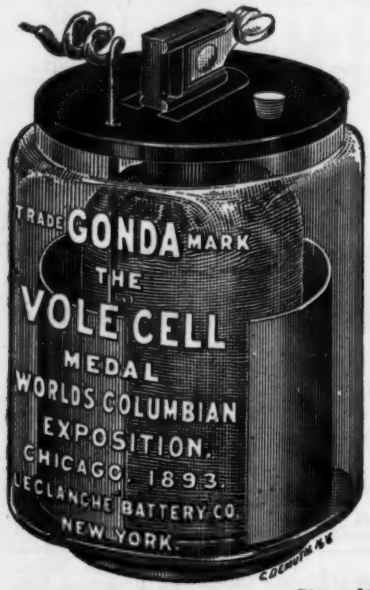


FOR MICA
Write to
ASHEVILLE MICA CO.,
ASHEVILLE, N. C.



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Send for Circular and Prices.
THE LECLANCHÉ BATTERY CO.
111 to 117 East 131st St., N. Y.

JUST FILTERS THE WASTE
THAT'S ALL.

But it means 50 per cent. of your oil bills saved, by using the

CROSS OIL FILTER.

Make a trial at our expense. We pay freight both ways if not satisfactory.

THE BURT MFG. CO.,
AKRON, OHIO, U. S. A.
Largest Manufacturers of Oil Filters in the World.

PORCELAIN LINED AND....
JAPANNED CAST IRON....

Outlet Boxes

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AUTO-STARTER
For direct connection to Elevators, Hoists, Dumb Waiters, or any service requiring a rapid start, stop and reversal of the motive power.
Automatic Switch Co.,
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You can increase the efficiency of your advertising by sending us NEW CUTS frequently.

The Value of Chloride Accumulators for Trolley Regulation.

The Union Traction Company of Philadelphia, after operating a battery of Chloride Accumulators on its system for five years, has recently contracted for five additional plants—one power house battery and four feeder batteries—a total battery capacity of 16,000 horse-power hours.

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Sales Offices { NEW YORK, 100 Broadway. BOSTON, - 60 State Street. CHICAGO, Marquette Building. BALTIMORE, Equitable Building. SAN FRANCISCO, Parrott Building.

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INSTRUMENTS

Meters—Switchboard and Portable
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Cable Testing Apparatus

CATALOGUES OF ANY ELECTRICAL OR SCIENTIFIC INSTRUMENT GLADLY FURNISHED.

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"Jagabi" Portable Testing Set.

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Absolutely Safe. A Paying Investment and Traffic Promoters.

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AMMETERS AND VOLTMETERS

for Switchboard Work.

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"AONE" PORTABLE TESTING SET.

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"Vac" Condensers
for telephone work; smallest, strongest and cheapest. Metal or wood boxes.

"Clover Leaf" Testing Batteries
do not explode, nor depreciate; high E.M.F. (1.25 volts per cell) and large amperage. Improved mountings. *Special circular free.*

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Telephone, 126 Cortlandt. 123 Liberty St., New York.

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ROUND PATTERN-Type D.
DUST PROOF METER.
For ALTERNATING CURRENT.

Shunt loss less than one Watt on 60 cycles.
Correct on induction loads. Starts on 5 Watts.

DIAMOND METER CO.,
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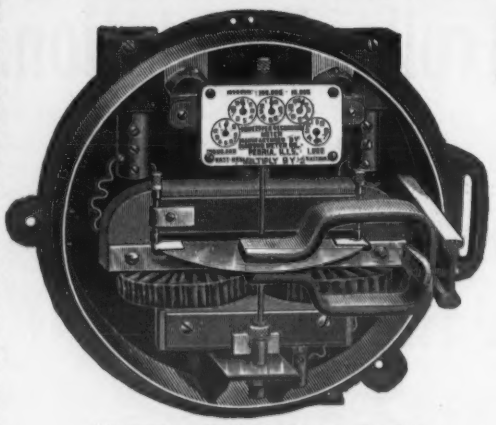
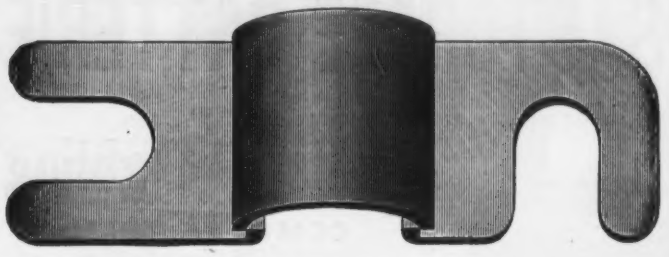


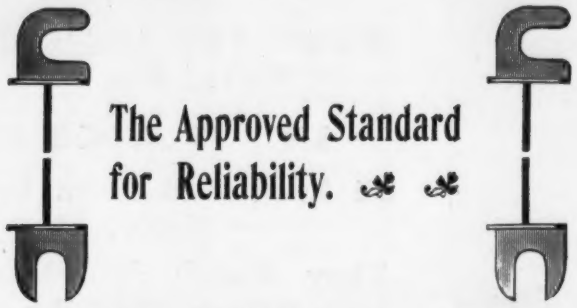
METER WITHOUT CASE.

METER WITH CASE.

SHAWMUT



TESTED FUSE WIRE AND LINKS



The Approved Standard for Reliability.

"CARTWRIGHT"

Enclosed Fuses . . .

A Fuse that will not operate at the proper time is worthless. The *Shawmut* and *Cartwright Fuses* are absolutely *Reliable* and *Accurate.* They work in every case.

Long experience, and testimonials from thousands of users, prove that *Our Fuses* are the *best* protectors on the market for *Light* and *Power Circuits.*

CHASE-SHAWMUT CO.

SOLE MANUFACTURERS,

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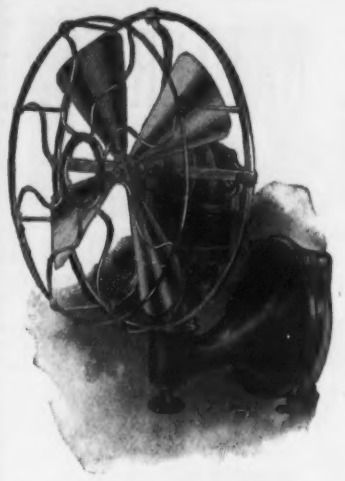

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FAN MOTORS

FOR

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CATALOGUE READY.

Made for 110, 220 and 500 volts.
12-inch and 16-inch Fans in both Desk and Bracket Style.

Repeated tests have shown that these fans are the most efficient on the market. . . . .

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MANUFACTURERS AND DEALERS,
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Arc and Incandescent Lamps, Wire, Cable,
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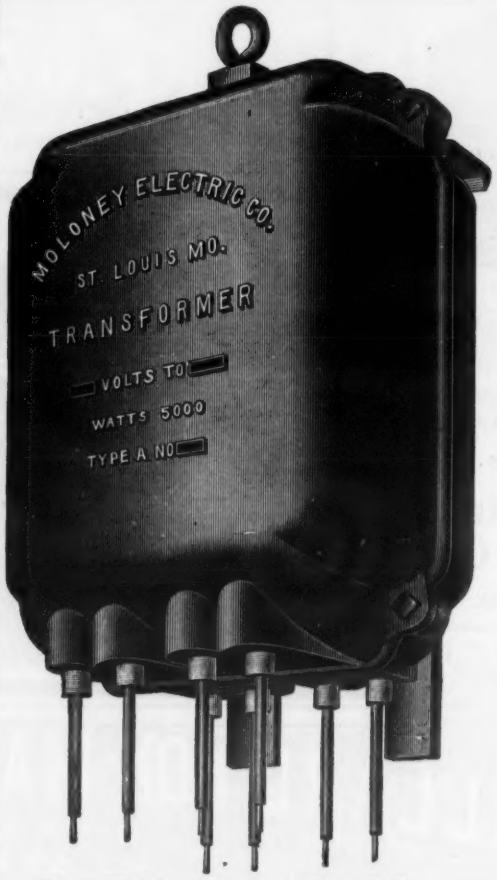

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WHY?

Because the Transformer needs no attention, and requires no repairs.

Designed for any Voltage, Frequency or Capacity.

Guaranteed for two years.

Export trade given special attention.

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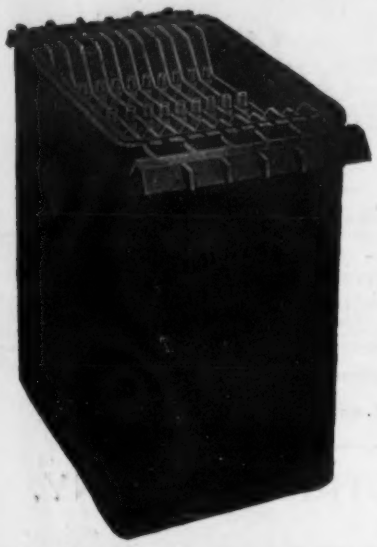
SOMETHING ENTIRELY NEW.

Giving **greater** efficiency and **less weight** than any other Storage Battery.



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Telegraphs,
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DO YOU REALIZE

WHAT YOU SAVE BY USING....

U. S. STORAGE BATTERIES

FOR

Auxiliary Lighting ?

COMPARE THEM:

44 U. S. Storage Cells=110 Volts.

Weight (60 Ampere-Hour Cells) 616 lbs.

IT TAKES

55 Lead-lead Cells to=110 Volts.

They Weigh (60 Ampere Hours) 1856 lbs.

2½ VOLTS.

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BRANCHES:

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Edison Jr. Primary Batteries and Fan Motors.

THE BEST IN THE MARKET.

8 Cell Battery, 15 Volts, 7½ Amperes.

On Exhibition and Sale at
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84 Nassau St., City, AND ALL DEALERS.

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FOR
GAS ENGINES,
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R. R. SIGNALS,
CROSSING BELLS
TELEPHONES,
MINIATURE LAMPS,
MEDICAL APPARATUS,
&C. &C. &C.

NEXT

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The Non-Polarizing Dry Battery Co.

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SMALL MOTORS
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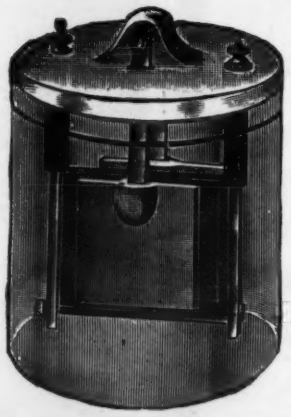

CONSTANT CURRENT
NO LOCAL ACTION
WILL NOT FREEZE
LIQUID TIGHT
CELLS
FOR
PORTABLE
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THOMAS A. EDISON
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Oxide Storage Batteries for All Purposes.

UNEQUALLED FOR EFFICIENCY, DURABILITY AND CHEAPNESS.

The Oxide Battery Company

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Electrodynamic Machinery

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Cloth. 331 pages, 232 illustrations.
Price, $2.50.

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FOR DESCRIPTIVE CIRCULAR WRITE A. C. BECKEN 103 STATE ST. - CHICAGO, ILL.

"FEDERAL SALT"

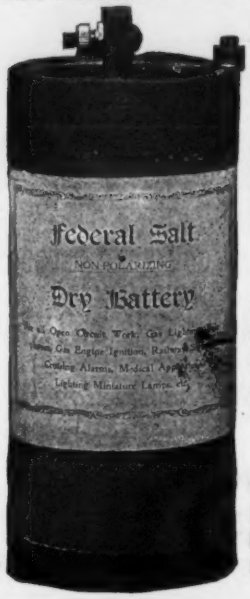
(Patented.)

FOR CARBON CYLINDER AND CARBON-MANGANESE BATTERIES.

GIVES MORE CURRENT, LONGER LIFE, ABSOLUTELY NO CRYSTALS.

FEDERAL SALT

NON-POLARIZING DRY BATTERY.



Wonderful Recuperation.

Higher Voltage and Amperage.

Will do more Hard Work than any Dry Battery on the Market.

No more Running Down on the Shelf.

Both salts have a depolarizer in the mixture. Federal Salt No. I has more depolarizer than Federalite, and so will last longer. That's the only difference.

It's the DEPOLARIZER that INCREASES the STRENGTH, GIVES LONGER LIFE, and DOES AWAY ABSOLUTELY with CRYSTALLIZATION and CREEPING SALTS.

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Please send References when ordering.

5c.

Package in case lots of 150 packages F. O. B. Bound Brook, N. J.

FEDERAL SALT No. I.

FEDERALITE.

3c.

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FEDERALITE SOLD IN BULK ALSO.

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DRY CELLS

are the result of years of research. They are NON-POLARIZING with HIGH VOLTAGE, LOW INTERNAL RESISTANCE, QUICK RECOVERY, and free from all local and chemical action.

We GUARANTEE all our cells for one year from date stamped on margin of each cell. If it fails within one year will furnish another free of charge. Cells and cases patented at home and abroad.

VOLTAMP ELECTRIC MFG. CO., 408-410 Jasper St., BALTIMORE, MD.

NO. 4 STANDARD MOTOR.

TEN YEARS OF SUCCESS.

STANDARD PORTER AND KENT MOTORS.

Our motors are solidly and substantially built.
Well finished and handsome.
We furnish them in black enamel, decorated in gilt, nickel trimmings.
For sale by all leading supply houses.

LET US TELL YOU ABOUT OUR **AJAX** AND **REX.**

KENDRICK & DAVIS, LEBANON, N. H., U. S. A.

Manufacturers of the PORTER AND KENT MOTORS.

THE AJAX.

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We beg to announce that on June 30, 1900, all connection between the **Perkins Electric Switch Manufacturing Company** of **Hartford, Conn.**, and **Mr. Charles I. Hills**, will be terminated.

Mr. J. E. Way, of the **R. Thomas & Sons Co.**, who succeeds **Mr. Hills**, will carry a complete line of **Perkins** goods at **39 Cortlandt Street, New York**, where all orders or communications will receive prompt and careful attention.

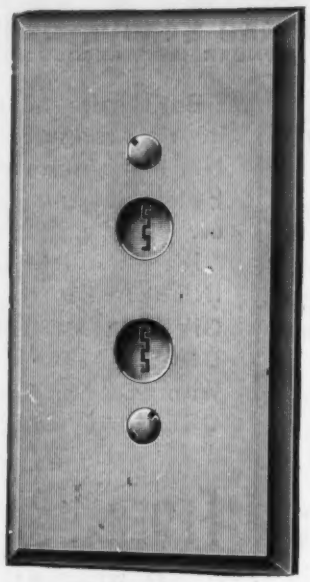
We thank you for your liberal patronage in the past, and solicit a continuance of the same.

The Perkins Electric Switch Mfg. Co.,

HARTFORD, CONN.

"Diamond H"

SWITCHES.



Lock Switch and Key.

This Switch is right in every particular.

TO GET OUR BEST PRODUCT
SPECIFY
"DIAMOND H" SWITCHES.

Write for Catalog A.

The Hart Manufacturing Co.,

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ATTIX FLEXIBLE TUBE WIRE

The India Rubber and Gutta Percha Insulating Co.

Main Office, Glenwood Works,

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YONKERS, N. Y.

Type "H" Voltmeter,—Illuminated Dial, Back of the Board Type, with WIDE FRONT.

Switchboard Instruments

that are

Absolutely Dead Beat

For Front or Back of the Board.

For Direct or Alternating Currents.

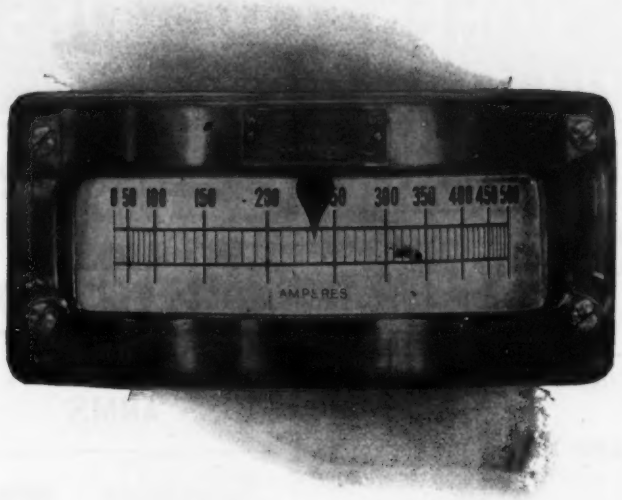
For

Accuracy,

Permanency

and

Sensitiveness



They

Are

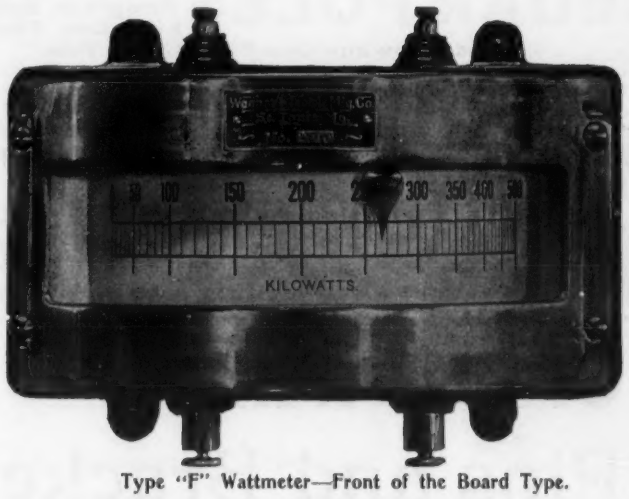
Unsurpassed.

Type "K" Ammeter—Illuminated Dial, Back of the Board Type, with NARROW FRONT.

Their **Dead Beatness** does not in the least affect them.

The **Pointers** swing from one position to a new position of rest **without any intermediate oscillation.**

Let us send you our Bulletins "Y 31 and 38" just issued, giving a detailed description of them.



Type "F" Wattmeter—Front of the Board Type.

Wagner Electric Mfg. Co.,

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ST. LOUIS, U. S. A.

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Prompt shipments.

Oak bills cut to order.

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Creaghead Mast Arms, MANY STYLES, FOR WOOD OR IRON POLES.

Manufacturers of Arc Lamp Specialties, Style 308 with safety pulley. Trolley Line Material.

Creaghead Flexible Brackets ARE STANDARD.

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Manufacturers and Dealers in
YELLOW PINE CROSS ARMS, LOCUST PINS, OAK PINS, ELECTRICAL MOULDINGS, OAK BRACKETS.
Large Stocks on Hand.
Delivered prices quoted, F. O. B. cars, your city, in any quantity. *Write us.*

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POLES. TIES.
PHILADELPHIA

Turned Wooden Goods FOR Electrical Purposes.

In foreign and domestic wood.

Switch Handles finished in imitation of hard rubber a specialty. Boxes, Bases, Push Buttons, Shells, etc.

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INDIANAPOLIS ARM BRACKET & PIN CO.
MANUFACTURERS OF
TELEPHONE AND TELEGRAPH INSULATOR PINS AND BRACKETS
....AND....
HARD WOOD LUMBER.
WAGON STOCK OF ALL DIMENSIONS.
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T. H. BRADY, New Britain, Conn., U. S. A.
Manufacturer of....
MAST ARMS, POLE and SWINGING HOODS, HOUSE BRACKETS and other Specialties for Construction Work.
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Chestnut Poles

All lengths for Electrical, Telephone, Telegraph, Spiling, Electric and Steam Railroad Ties. Prompt delivery. For prices address

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For Railway, Telephone, Telegraph and Electric Light Use. Pine Painted Crossarms and Oak Pins—Cedar Ties.

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Cross Arms, Pins and Brackets.

CONSTRUCTION MATERIAL.

LOWEST PRICES. ALL GOODS GUARANTEED.

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This Malleable Iron Bracket

is designed to use on roofs, top of cross arms, etc.

Like all our line of **Malleable Iron Brackets, Pins and Break-arms,** it bends under excessive strain but does not break. Is only one-third the weight of cast iron.

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DON'T ORDER Any more pins and brackets until you write **Gough & Davis,** manufacturers of the "G. D." Pins and Brackets. We can save you money. Locust pins our specialty.

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SYSTEM OF IMPREGNATION

will have three to four times the life of the unprotected timber.

This is the only system that insures a thorough, even and complete penetration of the wood, even to the innermost core, no matter what may be the size of the timber.

The wood is rendered impervious to atmospheric influences and greatly reduces its inflammability.

Our Pamphlet fully explains the process.

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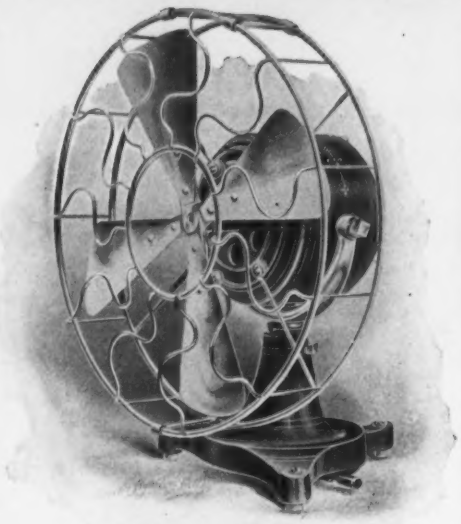
Direct-Current Search-Light Fans

12 and 16 inch Desk or Bracket

Four speeds on 110 or 220 volts.



For series running on 500 v. there is no speed controller, but the fans may be stopped independently.

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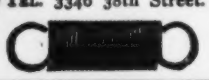

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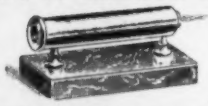

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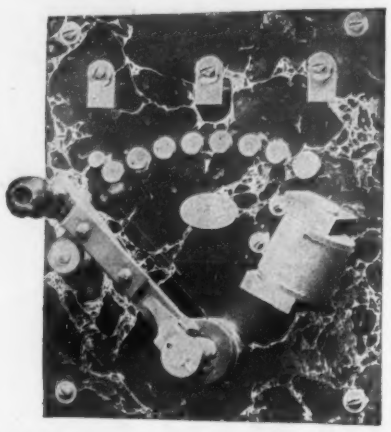

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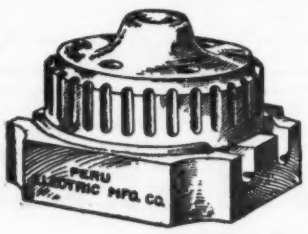

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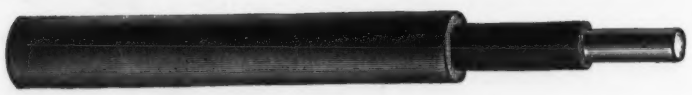

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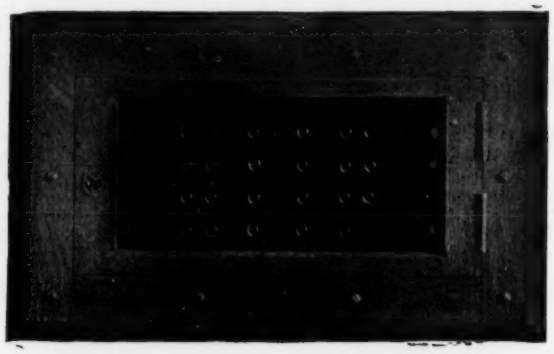

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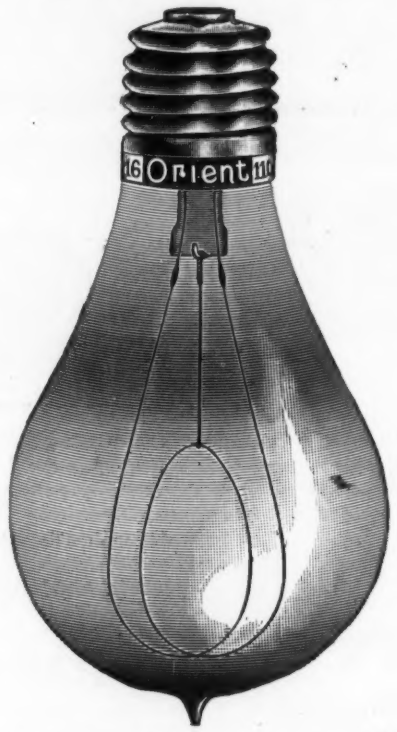

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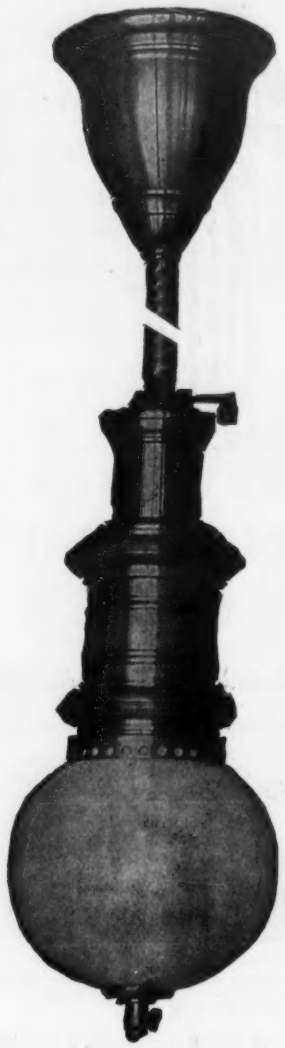

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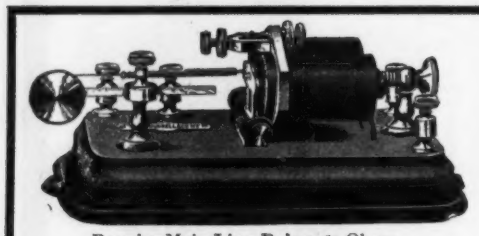

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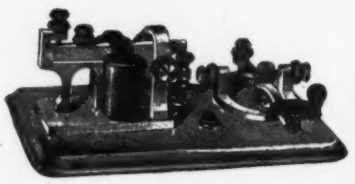

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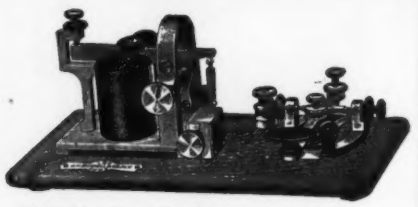

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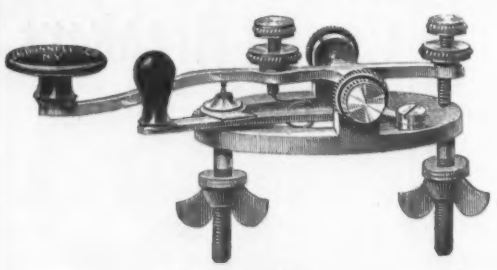
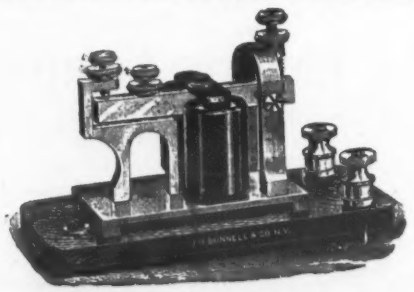
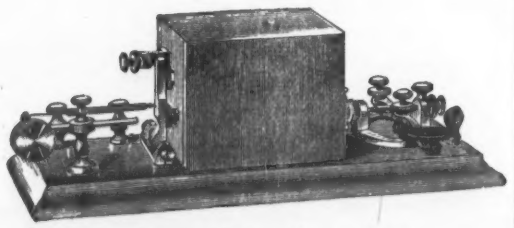


Steel Lever Key.



Giant Sounder with Aluminum Lever.



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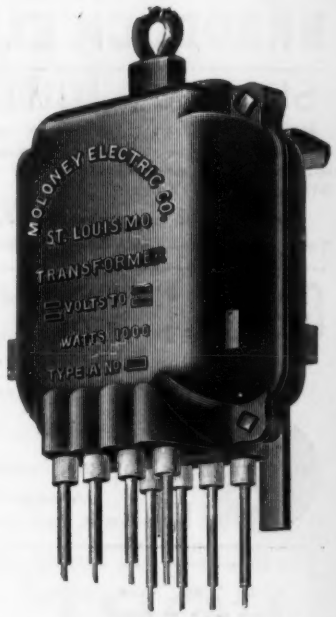

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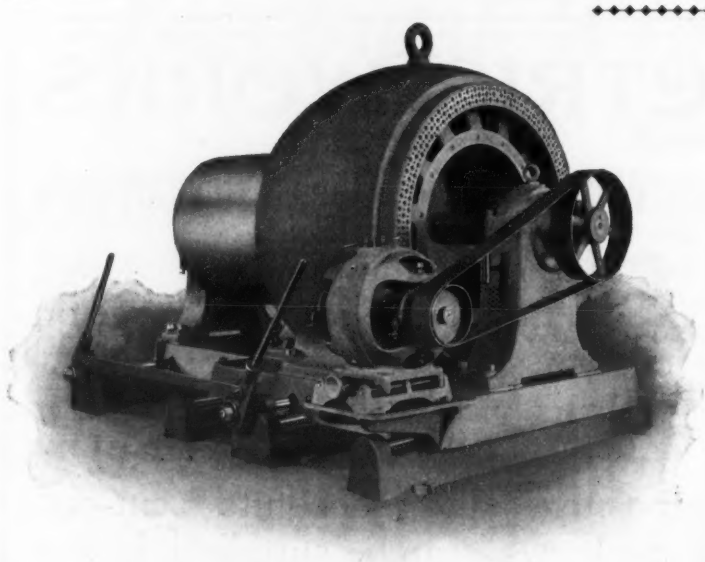

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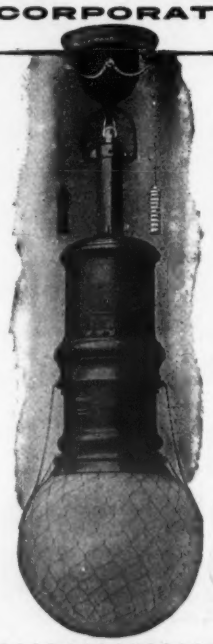

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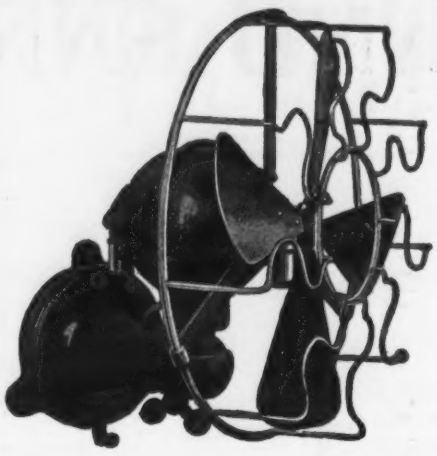

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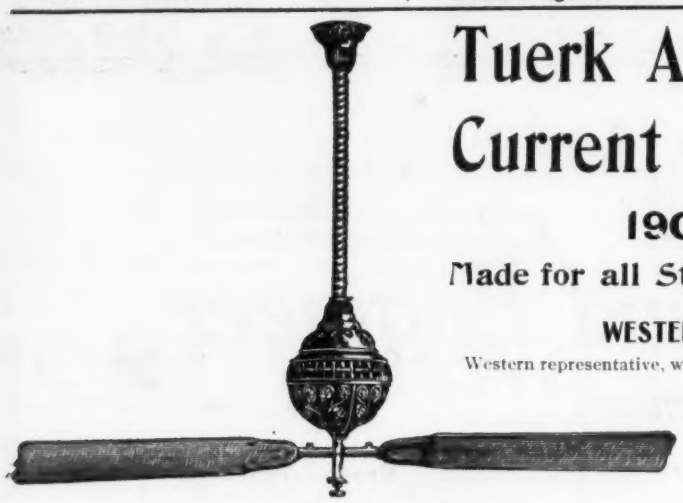

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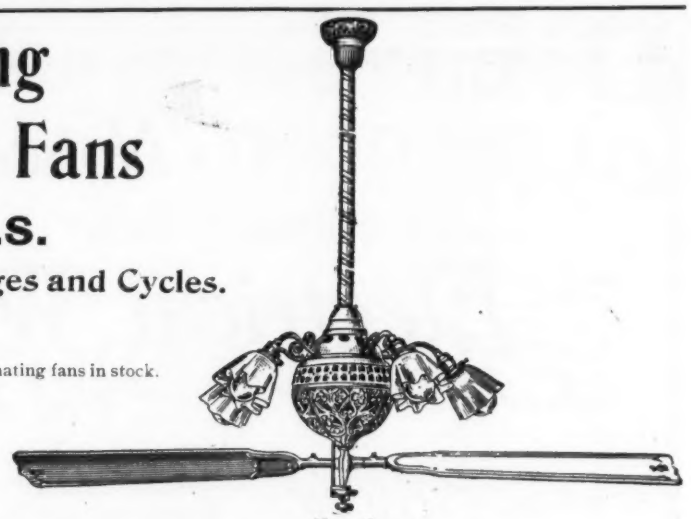

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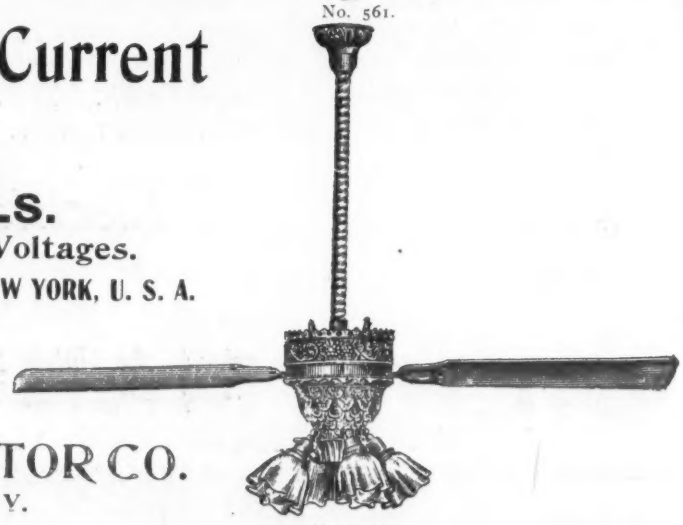

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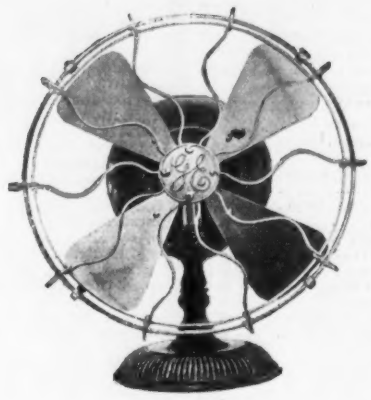

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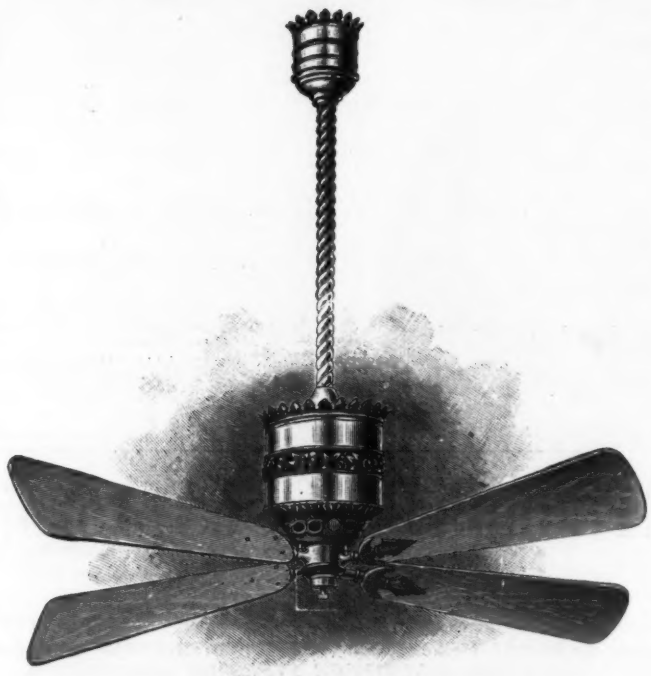

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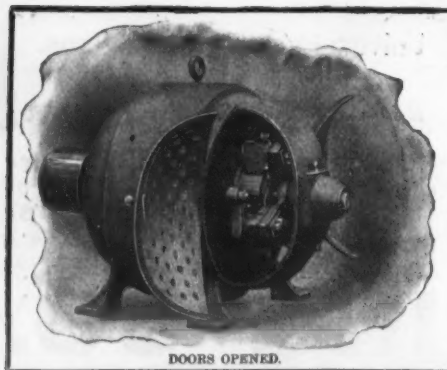

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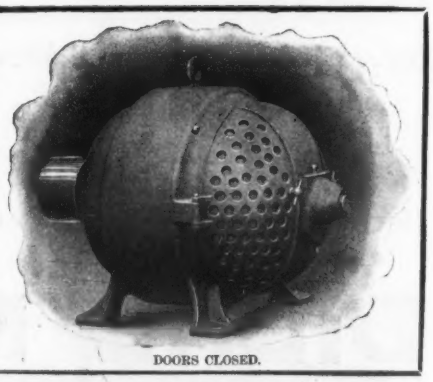

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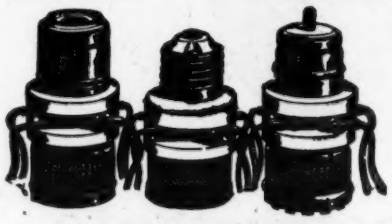

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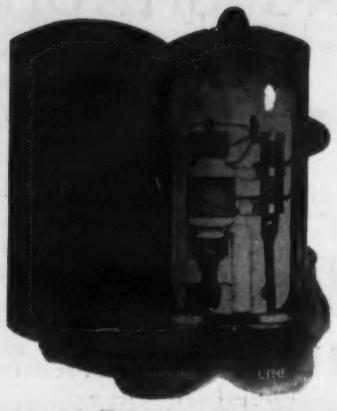

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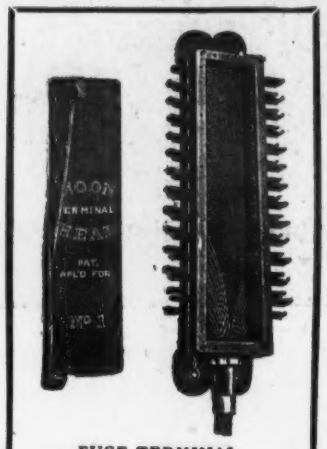

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Partrick, Carter & Wilkins.

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Peterson & Co., John L.

ASBESTOS.
Johns Mfg. Co., H. W.

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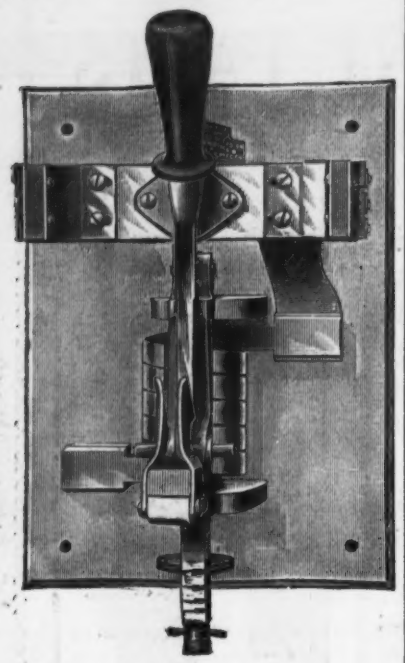

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Diehl Manufacturing Co.
Eck Dynamo & Motor Works.
Falcon Electric Mfg. Co.
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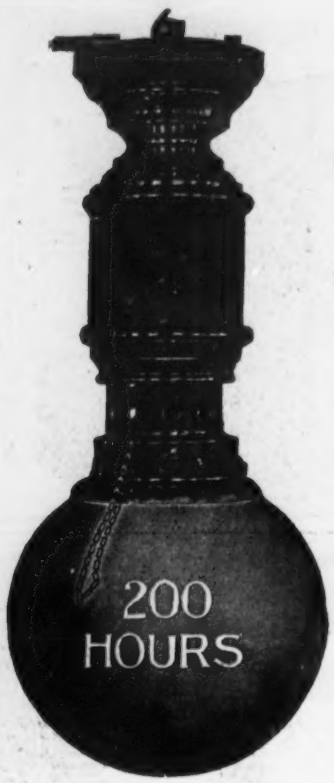

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Krantz, H.

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Webster Chemical Co.

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Ball Electric Co.
Belden-Larwill Electric & Mfg. Co.
Bogue, C. J. (Photographic).
Colonial Elec. Co.
Continental Elec. Co.
General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Guarantee Electric Co.
Interstate Elec. Co.
Jandus Elec. Co.
Lea Electric Mfg. Co.
Machado & Roller.
Manhattan General Const. Co.
Pelton Engineering Co.
Sterling Arc Lamp Co.
Toerring Co., C. J.
Western Electric Co.
Western Electric Supply Co.
Westinghouse Electric & Mfg. Co.

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Buckeye Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Columbia Incandescent Lamp Co.
Edison Dec. & Min. Lamp Dept.
Electric Contract Co.
General Electric Co.
General Incandescent Arc Light Co.
Gilmore Electric Co.
Goodchild & Welsh.
Guarantee Electric Co.
Hardy Lamp Co., The.
Lynn Incandescent Lamp Co.
Machado & Roller.
McCreary & Co., A. A.
New York & Ohio Co.
Pelton Engineering Co.
Reliance Lamp Electric Co.
Sawyer-Man Electric Co.
Shelby Electric Co.
Warren Electric & Specialty Co.
Western Electric Co.

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Moon Mfg. Co.
Viaduct Mfg. Co.
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Lunkenheimer Co., The.

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Bliss Co., E. W.
Bradford Machine Tool Co.
Burnham Co., Geo., The.
Cincinnati Milling Machine Co.
Dreses, Mueller Co.
Ferracute Machine Co.
Garvin Machine Co.
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Philadelphia Machine Screw Works.
Pond Tool Co.
Sebastian Lathe Co.
Seneca Falls Mfg. Co.
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Cutter Co., George.

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Sturtevant Co., B. F.

METAL POLISH.
Hoffman, George W.
Martinez, H.

METAL REFINING.
Swarts Metal Refining Co.

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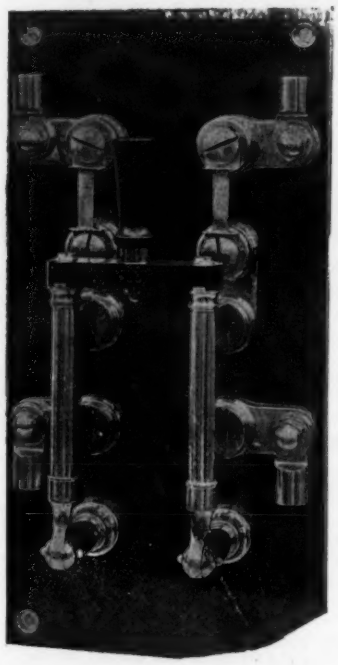

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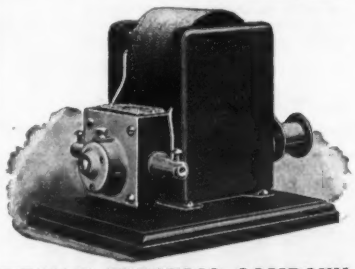

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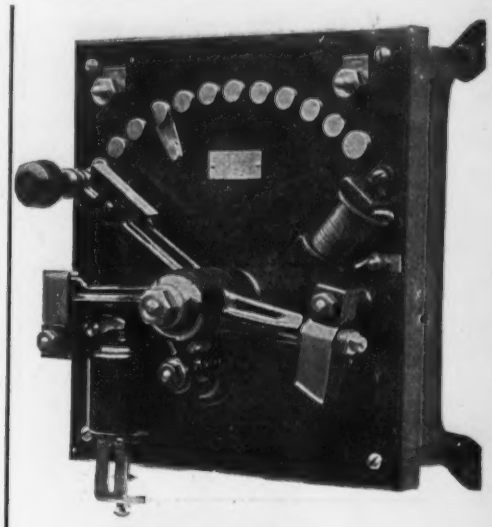

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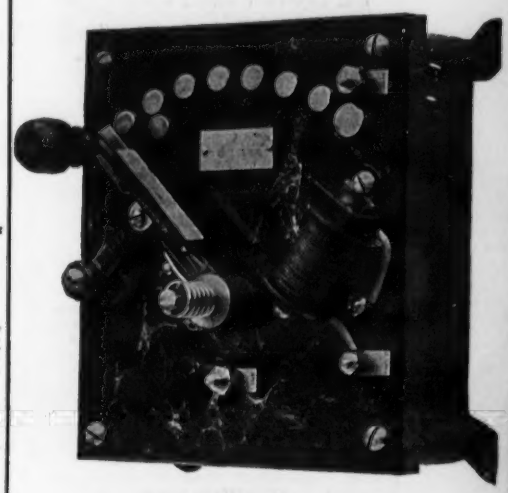

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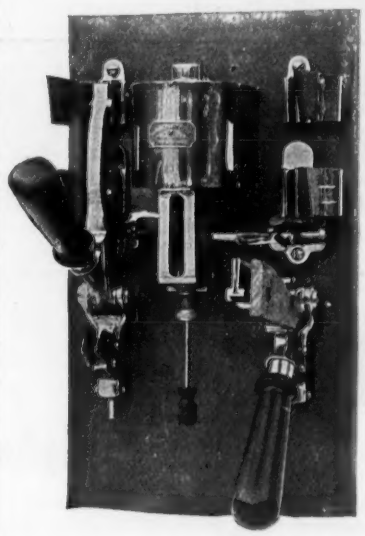

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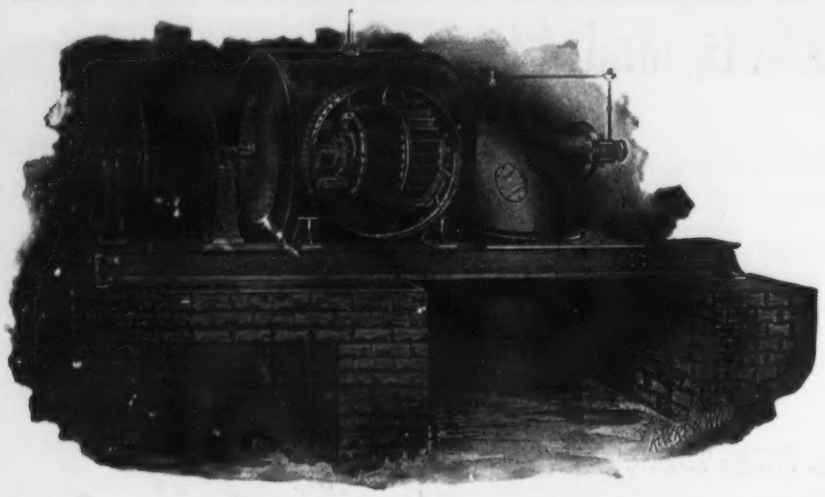

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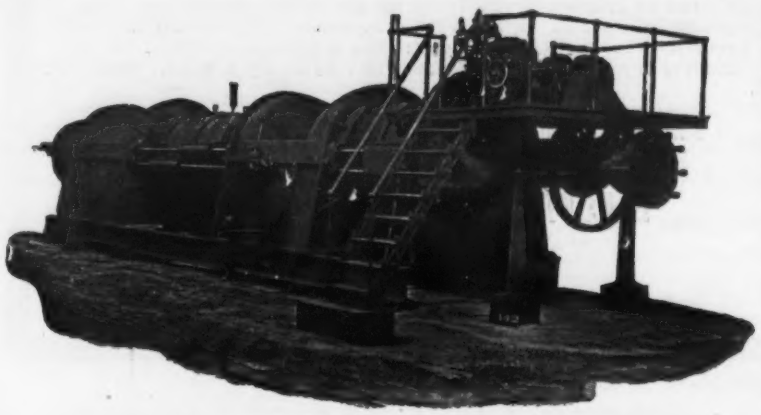

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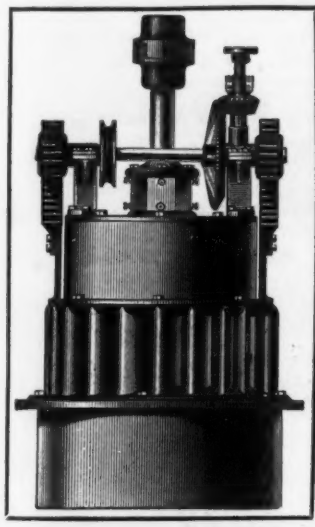

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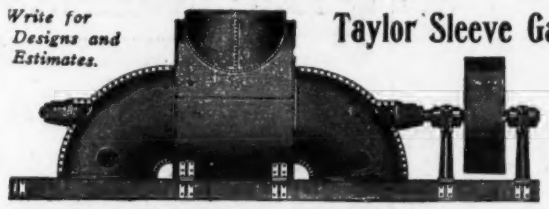

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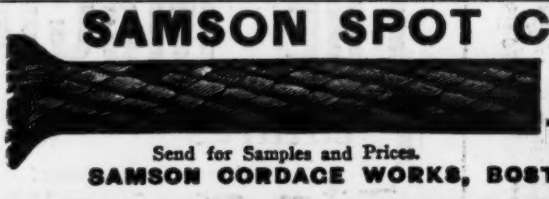

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ELECTRICAL MACHINERY

ALTERNATORS.

1 450-kw Westinghouse, single phase, 2200 volts, 7200 alternations, speed 257 r. p. m.
1 525-kw Westinghouse, two-phase, 2200 volts, 72 alternations, speed 257 r. p. m.
2 240-kw Stanley, two-phase, 380 r. p. m., with engines direct connected.
2 300-kw Westinghouse, single phase, toothed armatures.
1 220-235-kw Westinghouse, single phase, 1100 volts, 450 r. p. m., 7200 alternations.
1 250-kw Westinghouse, two phase, 1100 volts, 450 r. p. m., 7200 alternations.
1 150-kw Westinghouse, two-phase, 1100 volts, 600 r. p. m., 7200 alternations.
2 A-120 General Electric, single phase, 1000 volts, 16,000 alternations.
8 90-kw Gen. Elec., single phase, 1000 volts, 16,000 alternations.
2 120 Westinghouse, single phase, 1100 volts, 16,000 alternations.
1 75-kw General Electric, two-phase, 2300 volts, 60 cycles.
2 75 kw monocyclic General Electric, 200 volts, 7200 alternations, with exciters.
1 60-kw General Electric, single phase, 2000 volts, 16,000 alternations.
1 60-kw Westinghouse, two-phase, 2200 volts, 60 cycles.
1 45kw Westinghouse, 2200 volts, 16,000 alternations.
2 A-70 T.-H., 1 000 volts, 16,000 alternations.
1 150-kw Fort Wayne, 2200 or 1100 volts, 16,000 alternations.
2 75-kw Fort Wayne, 2200 or 1100 volts, 16,000 alternations.
2 75-kw Stanley, 2400 volts, two-phase, 16,000 alternations.

DIRECT CURRENT DYNAMOS.

110 VOLTS.

(Direct Connected.)

2 100-kw Westinghouse, 8-pole, 225 r. p. m., direct connected to McIntosh & Seymour compound engines.
2 100-kw units, consisting of one straight line engine and two 50-kw General Electric, 6-pole generators, one on either side of the engine, 250 r. p. m.
1 100-kw Siemens & Halske, direct connected to 15x16 inch straight line engine, 238 r. p. m.
1 75-kw Siemens & Halske, direct connected to 12x14 inch straight line engine, 278 r. p. m.
1 60-kw Westinghouse, 6-pole, direct connected to Atlas engine, 250 r. p. m.

BELTED DYNAMOS.

110 VOLTS.

2 150-kw Edison Bipolar.
4 100-kw " "
4 60-kw " "
4 45-kw " "
4 30-kw " "
4 25-kw " "
2 20-kw " "
2 15-kw " "
2 10-kw "
1 500-ampere Onondaga.
1 340-ampere Eddy.
1 25-kw Electro Dynamic.
1 15-kw Westinghouse, horizontal type.
1 30-kw Western Electric, M.P., 500 r. p. m.
1 45-kw Westinghouse, M. P., 850 r. p. m.

DIRECT CURRENT MOTORS AND GENERATORS.

220 VOLTS.

(Direct Connected.)

2 75-kw Westinghouse, M. P., direct connected to Westinghouse engines.
1 75-kw General Electric, direct connected to Ideal engine.
1 80-kw Churchward, direct connected to Russell engine.

(Belt Driven.)

1 100-kw Edison.
1 80-kw Siemens & Halske.
1 45-kw General Electric, M. P., 800 r. p. m.
1 35-hp U. S., 775 r. p. m.
1 20-hp Westinghouse, M. P., 600 r. p. m.

DIRECT CURRENT.

500 VOLTS.

2 60-kw Edisons.
1 50-hp C & C, 700 r. p. m.
1 30-hp, moderate speed, M. P., Westinghouse.
1 25-hp T.-H.
1 25-hp Keystone.
1 25-hp M. P. Eddy.
1 20-hp M. P. Westinghouse.
1 15-hp M. P. Eddy.
1 15-hp M. P. General Electric.
1 10-hp Eddy.
1 3-hp Sprague.

RAILWAY GENERATORS.

2 850-kw General Electric, 80 r. p. m., direct connected to Allis cross compound engines.
2 425-kw General Electric, 100 r. p. m., direct connected to Allis cross compound engines.
1 800-kw Walker, for direct connection.
2 500-kw General Electric M. P., belt driven.
2 500-kw Westinghouse, M. P., belt driven.
2 375-kw Westinghouse M. P., belt driven.
2 200-kw General Electric M. P., belt driven.

ARC DYNAMOS.

2 165-light, multi-circuit Brush, 1200 cp, $2000 each.
2 No. 11, 125-light, multi-circuit, 2000 cp, $1950 each.
2 125-light, single-circuit, 200 cp, Brush, $1700 each.
2 125-light, latest type Fort Wayne, 2000 cp, $1500 each.
2 125-light, brand new Excelsior, 2000 cp, $1500 each.
4 No. 8, 65-light, 2000 cp, Brush, $575 each.

ENGINES.

22 x 40 in. x 48 in. Tandem Harris Corliss.
26 in. x 60 in. Harris Corliss.
18 in. x 42 in. Knowlson & Kelly Corliss.
18½ in. x 18 in. Armington & Sims, heavy duty.
11 in. x 19 in. x 24 in. Tandem Comp. Buckeye.
1—600 H.P. Nordberg Jet Condenser.
1—350 H.P. Worthington Jet Condenser.
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ALTERNATING GENERATORS.

1 350-light Thomson-Houston, A18.
1 600 " Bain, 30 K.W., self-oiler, new toothed armature.
1 600 " T.-H., A6, 30 K.W.
1 600 " T.-H., 30 K.W., two-phase, 1100 volts.
1 650 " T.-H., A35, s. o.
2 750 " Westinghouse, 37½ K.W.
1 900 " 60-cycle Westinghouse, 45 K. W., s. o., with newly wound toothed armature.
1 1000 " Wood, 50 K.W., s. o., toothed armature.
1 900 " Warren, inductor type.
2 1200 " Westinghouse, 60 K.W., self-oiler, toothed armature.
1 1400 " Westinghouse, 70 K.W.
2 6000 " Westinghouse, 300 K.W., toothed armature, composite wound, self-oilers, out board bearings.
1 6000 " Westinghouse, 300 K.W., 2200 volts, toothed armature, composite wound, self-oiler, out board bearings.

ARC DYNAMOS.

1 20-light C.P. Western Electric.
1 25 " 2000 " T.-H.
1 30 " 2000 " Western Elec., s. o.
1 30 " 2000 " Brush, No. 7.
2 35 " 2000 " T.-H., LD2.
1 40 " 2000 " Wood, No. 7.
2 40 " 2000 " Western Elec., s. o.
1 45 " 2000 " T.-H., M12, ring art.
4 45 " 1200 " Brush, No. 7.
1 50 " 2000 " Excelsior, latest type.
2 50 " 1200 " T.-H., LD12.
1 50 " 2000 " Western Elec., s. o.
1 50 " 2000 " Brush, No. 7½.
2 60 " 2000 " Western Elec., s. o.
1 60 " 2000 " Westinghouse, tooth. arm't, 6-pole, D. C., s. o., complete with exciter.
3 60-light 2000 C.P. Wood, No. 8.
3 65 " 2000 " Brush, No. 8, new armature.
2 75 " 1200 " Standard.
1 75 " 2000 " Westinghouse, s. o., toothed arm't, D. C., 6-pole, complete with exciter.
3 125 " 1200 " Excelsior, latest type, self-oilers.

110-VOLT INCANDESCENT DYNAMOS.

2 12-light Edison, ¼ M.P.
1 25 " C & C, self-oiler.
1 35 " Westinghouse, self-oiler.
1 36 " Bernard, self-oiler.
1 50 " Hawkeye, self-oiler.
1 50 " Bain, self-oiler.
1 50 " Card, self-oiler.
2 90 " Westinghouse.
1 160 " Rockford.
1 180 " Westinghouse.
1 250 " Commercial comp., self-oiler.
1 260 " National comp., self-oiler.
1 270 " T.-H. comp., self-oiler.
1 300 " Eickmeyer.
1 340 " Eddy, self-oiler, compound.
2 350 " Hawkeye, comp. wound.
1 350 " National, self-oiler, comp.
3 350 " Edison, 20 K.W., self-oiler.
1 360 " Rockford, self-oiler, comp.
1 450 " Edison, 25 K.W., self-oiler.
1 400 " Wood, M.P., self-oiler.
1 450 " Rockford, self-oiler.
1 540 " Edison, 30 K.W., oil cup.
4 540 " Edison, 30 K.W., s. o., comp.
1 540 " Westinghouse, 3-pole, s. s., 30 K.W., self-oiler, new.
1 600 " E. & C., slow speed, M.P., self oiler, compound.
1 600 " Eickmeyer.
2 700 " Siemens & Halske, 40 K.W., M.P., slow speed.
2 700 " Westinghouse, 10-pole, s. s., 40 K.W., self-oiler, new.
1 800-light Rockford, s. o., new arm't.
4 800 " Edison, 45 K.W., self-oilers.
1 1350 " Waddell-Entz, 80 K.W., M.P., for direct connection.

500-VOLT GENERATORS.

1 25 K.W. T.-H., self-oiler, D25, comp.
1 25 " Edison, self-oiler.
1 30 " Jenney, self-oiler.
1 35 " Jenney, self-oiler.
1 35 " Mather, self-oiler.
1 45 " Edison, comp., self-oiler.
1 150 " Detroit, M.P., comp. s. o.

DIRECT CONNECTED RAILWAY GENERATORS.

1 100 H.P., 500-volt Westinghouse, Kodak set Westinghouse generator and Westinghouse comp. engine 14x24x14, all complete, fine.

110-VOLT MOTORS.

1 1 H.P. Edison.
1 1½ " C & C, self-oiler.
1 2 " Westinghouse, self-oiler.
1 3 " Westinghouse.
1 3 " Bain, self-oiler.
2 7½ " Westinghouse.
1 12 " Rockford.
1 18 " National, self-oiler.
1 18 " Commercial, self-oiler.
1 18 " T.-H., self-oiler.
1 20 " Eickmeyer.
1 24 " Eddy, self-oiler.
2 25 " Hawkeye motors.
1 25 " Rockford.
2 30 H.P. Edison, 25 K.W., self-oilers.
1 25 " National, self-oiler.
4 25 " Edison, 20 K.W., self-oilers.
1 30 " Rockford.
1 30 " Wood, M.P., self-oiler.
1 35 " Edison, 30 K.W., oil cups.
7 35 " Edison, self-oilers.
1 35 " Westinghouse, 8-pole, s. s., 30 K.W., self-oiler, new.
1 40 " E. & C., M.P., slow speed.
1 40 " Eickmeyer.
1 50 " Siemens & Halske, M.P., s. o., slow speed.
2 50 " Westinghouse, 10-pole, s. s., 50 K.W., self-oilers, new.
1 60 " Rockford, self-oiler.
4 60 " Edison, 45 K.W., self-oilers.

220-VOLT MOTORS.

2 1 H.P. E. & C., new, s. o., M.P., s. s.
1 1 " Commercial, self-oiler.
1 3 " Crocker-Wheeler, s. o., s. s.
2 3 " Card, slow speed, self-oiler.
1 5 " T.-H., self-oiler.
1 5 " Westinghouse, self-oiler.
1 7½ " Roth, self-oiler.
2 7½ " Eddy, self-oilers.
1 7½ " Edison, self-oiler.
1 12 " T.-H., self-oiler.
1 16 " Crocker-Wheeler, elevator motor, with controller.
1 50 " Northern, M.P., s. o.
1 60 " Edison, self-oiler, 45 K.W.

500-VOLT MOTORS.

2 1 H.P. Jenney, self-oilers.
3 1 " Crocker-Wheeler, s. o., s. s.
1 1 " Lundell, self-oiler, slow speed.
1 2½ " Wood, self-oiler.
1 3 " Toledo, self-oiler.
1 3 " Jenney, self-oiler.
1 3 " Thomson-Houston.
2 3½ " Rockford, iron clad, s. o.
1 7½ " Jones, self-oiler.
1 10 " Eddy, self-oiler, M.P.
1 10 " C & C, self-oiler.
1 10 " Card, M.P., s. o., s. s.
1 18 " Thomson-Houston.
2 18 " C & C, self-oilers.
1 20 " Commercial, self-oiler.
1 20 " Card, self-oiler.
1 30 " T.-H., self-oiler.
1 30 " Edison, 25 K.W., self-oiler.
1 35 " Jenney, self-oiler.
1 40 " Jenney, self-oiler.
1 40 " Mather, self-oiler.
1 60 " Edison, 45 K.W., self-oiler.

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DYNAMOS.

1	100	K.W.	M.P. West, 6-pole.
1	100	"	M.P. G. E., 4-pole.
2	60	"	M.P. West.
1	D50	"	T.-H.
2	150	"	1-76A, 125-volt, 220-rev. Siemens-Halske.
4	45	"	Edison Bipolar.
2	30	"	" "
2	25	"	" "
1	20	"	" "
1	15	"	" "

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1—8x9 N. Y. Safety.
1—11x12 N. Y. Safety.
1—13x12 N. Y. Safety.
1—16x16 Ball.
1—14x18 Russell.
1—13x24x18 Atlas.
1—13x20x15 Dick & Church.
1—14x27x24 Lake Erie.
1—100 H.P. West.
1— 65 " "
1—250 " "

MOTORS.

1—125	H.P.	G. E., 125-volt.
1—100	"	T.-H., 125-volt.
1— 3	"	Crocker-W., 220-v.
1— 3	"	Crocker-W., 125-v.
1— 2	"	Lundell, 125-volt.
1— 2	"	Lundell, 220-volt.
1— 10	"	E. D., 125-volt.
1— 5	"	Ft. Wayne Alt., s.-p.
1— 10	"	Excelsior Alt., s.-p.
1— 1	"	Ft. Wayne Alt., s.-p.
1— 30	"	West, two-phase.

ALTERNATORS.

2— 120	K.W.	G. E.
2— 70	"	"
2— 60	"	"
1— 240	"	"
1— 30	"	"
2—A35	"	"
2— 75	"	West.
2— 60	"	"
2— 45	"	"
2— 30	"	"
1— 100	"	Ft. Wayne.

FAN MOTORS, SINGLE-PHASE, 16,000 ALTERNATIONS.

30—G. E., 104 volts.
35—Emerson, 104 volts.
10—Emerson, 52 volts.
12—West, 104 volts.
12—West, 52 volts.
$6.50 each.
6— 85-volt, D.C. Ceiling fans.
5—100 " " " "
5—100 " " " "
6—170 " " " "
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1— 12-light Elbridge, s. o., new.
1— 100-light Daft.
1— 250-light U. S.
1— 350-light Davis.
2—1100-light Edison, 60 K. W.

ARC DYNAMOS.

1	Brush,	1 light,	3000-cp.
1	Brush,	3 light,	2000-cp.
2	American Wood,	20 lights,	2000-cp.
1	Western Electric,	30 lights,	2000-cp.
1	T.-H., L. D.-2,	35 lights,	2000-cp.
1	Wood No. 6,	35 lights,	1200-cp.
1	Wood No. 8,	75 lights,	1200-cp.

GENERATORS.

1 U. S., 15-kw, 110 volts.
1 Davis, 22-kw, s. o., 110 volts.
2 Edison, 60-kw, 110 volts.
1 Ft. Wayne, 6-pole, 100-kw, 110 volts, new.
1 Edison, 12-kw, s. o., 220 volts. compound,
1 Wood B. P., 45-kw, s. o., 500 volts.
1 Edison No. 20, 60-kw, s. o., 500 volts.
1 T.-H., D—62, 62-kw, s. o., 500 volts.
1 T.-H., M.P.—75, 75-kw, s. o., 500 volts.
1 Edison No. 32, 100-kw, s. o., 500 volts.

ALTERNATING GENERATORS.

3—3A Slattery, 1300 lights, 16,000 alternators, 1100 or 2200 volts, s. o., with exciters.
2—T.-H. A35, 650 lights, 15,000 alternators, 1100 volts, composite wound, with exciters.

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1/6-hp Diehl, s. o.
1/2-hp C & C.
3/4-hp Elbridge, s. o.
1-hp Sprague.
3-hp Nowotny.
10-hp Daft.
20-hp U. S.
28-hp Queen City, s. o.
2—75-hp Edison No. 20.

MOTORS—220 VOLTS.

3 hp Hobart, s. o.
5 hp T.-H., D Class 10, s. o.
7 1/2 hp C & C.
10 hp E. R. & C. C., s. o.
10 hp Daft, 800 r. p. m.
15 hp Edison, s. o.

MOTORS—500 VOLTS.

1/4-hp Keystone, s. o.
1-hp Westinghouse M. P., s. o.
5-hp T.-H., D Class 10.
15-hp C & C, s. o.
20-hp Davis, s. o.
25-hp Brush, 350 r. p. m.
60-hp Wood B. P., s. o.
70-hp Edison B. P., s. o.
75-hp T.-H. D., s. o.
90-hp T.-H., M. P., s. o.
120-hp Edison B. P., s. o.

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1	H.P.	110 Eddy.
2	"	110 Eddy.
3-12	"	110 Elec.-Dynamic.
1	"	220 C & C.
2	"	220 Sprague.
2	"	220 Excelsior.
3	"	220 Mayer.
3	"	220 Sprague.
10	"	220 T.-H.
20	"	220 C & C.
10	"	550 C & C.

DYNAMOS.

15-light		Cleveland.
30	"	West.
75	"	Mayer.
100	"	Western Elec.
2-160	"	Elec.-Dynamic.
300	"	U. S.
450	"	Onondaga.
15	K.W.	Detroit.
20	"	T.-H.
2- 45	"	West, M.P., almost new.
2- 85	"	Wenstrom.
1-100	"	West, 6-pole.

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30 H.P. Paine.
45 " M. & S.
60 " Ames.

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2—100-kw Edison bipolar, 140 volts.
2—100-kw Wood, 125 volts, 6-pole, new.
1—30-kw Edison bipolar, 125 volts, comp.
1—15-kw Edison bipolar, 125 volts, comp.
2—150-kw, 500 volts Edison bipolar, comp.
1—60-kw Westinghouse, 2-phase, 60-cycle.

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Two Fort Wayne Dynamos, 32½-kw, complete with instruments, 1000 volts.
One 600-light United States Dynamo, 110 volts.
Two 350-light Richter Dynamos (bipolar), 110 volts.
One 225-light Waddell-Entz Dynamo (multipolar), 110 volts, 12-kw.
One 200-light Richter Dynamo (bipolar), compound, 110 volts.
One 200-light Quaker City Dynamo (bipolar), compound, 110 volts.
One 100-light Consolidated Dynamo, 110 volts.
One Westinghouse, 40-arc-light Alternating Dynamo, 2000-cp, self-exciting.
Two 35-arc-light American Wood Dynamos, self-regulators, 2000-cp.
One 20-arc-light American Wood Dynamo hand regulator.
One 25-hp C & C Motor, 220 volts, A No. 1 condition.
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One 6-hp Edison Motor, 220 volts.
Large stock of small Motors and Dynamos.
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2-120 K.W. West'ghouse.	1-150 Lt. Claus.	Fort Wayne 1000 to 100.
2-120 " Gen. Elec.	1-175 " West'ghouse.	50- 12 Light.
1-100 " Gen. Elec.	2-175 " U. S.	40- 25 "
1- 90 " Fort Wayne.	1-400 " U. S.	8- 50 "
2- 75 " West'ghouse.	1-500 " Loomis.	3- 75 "
1- 60 " Stanley.	3- 20 K.W. Edison.	1-125 "
3- 60 " Gen. Elec.	2- 25 " Edison.	1-150 "
1- 50 " Fort Wayne	1- 30 " Edison.	1-250 "
1- 50 " West'ghouse.	1- 30 " Claus.	
2- 37 " West'ghouse.	1- 45 " Edison.	
4- 35 " T.-H.	1- 75 " Ft. Wayne	
1- 30 " Gen. Elec.	2-100 " Gen'l Elec.	Special low price.

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110 VOLT GENERATORS.

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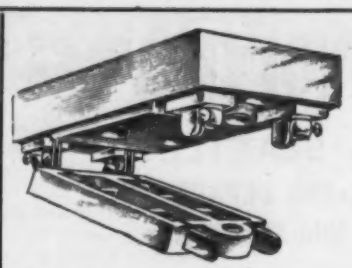

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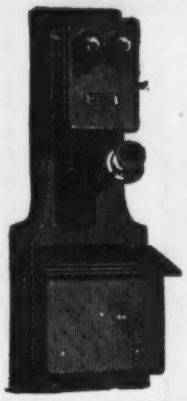

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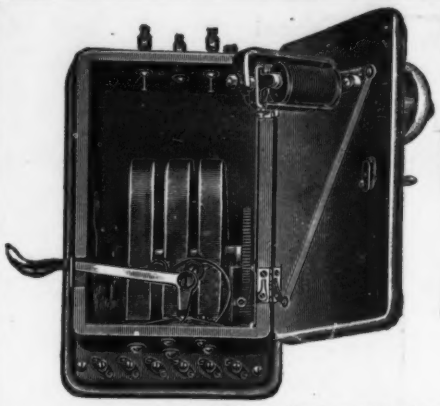

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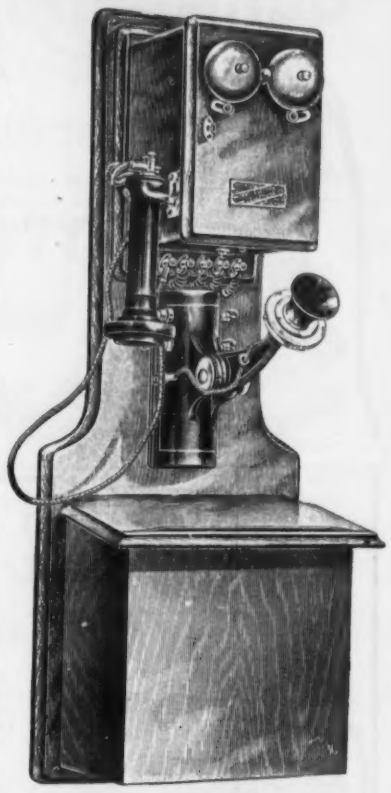

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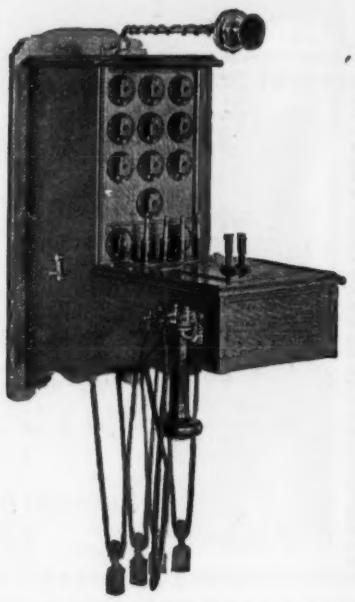

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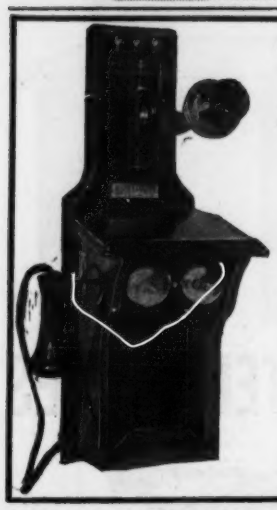

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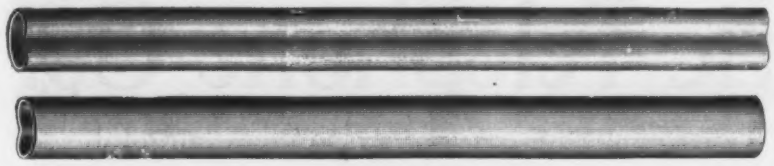

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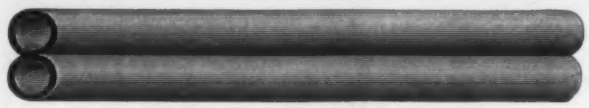

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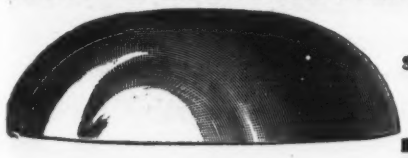

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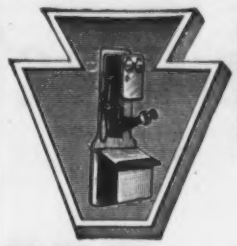

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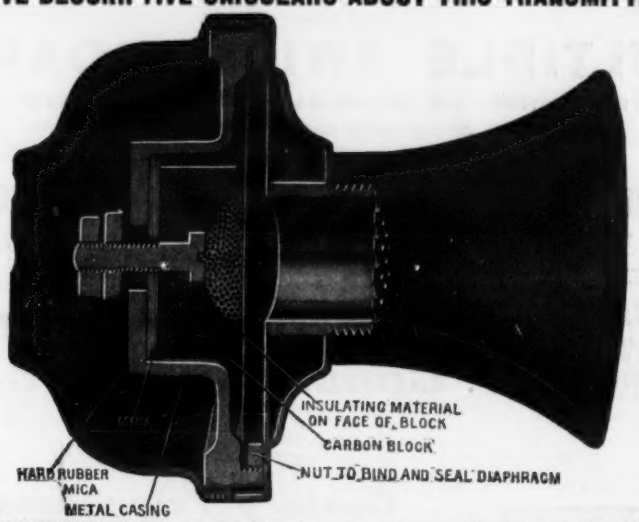

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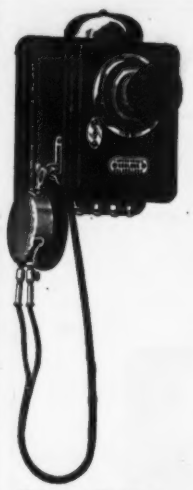

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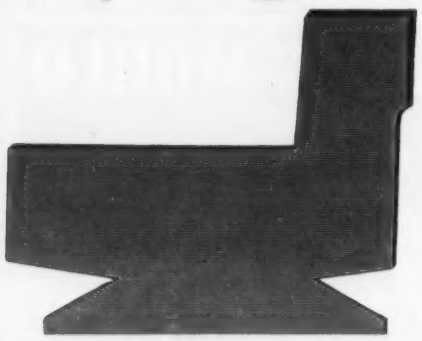

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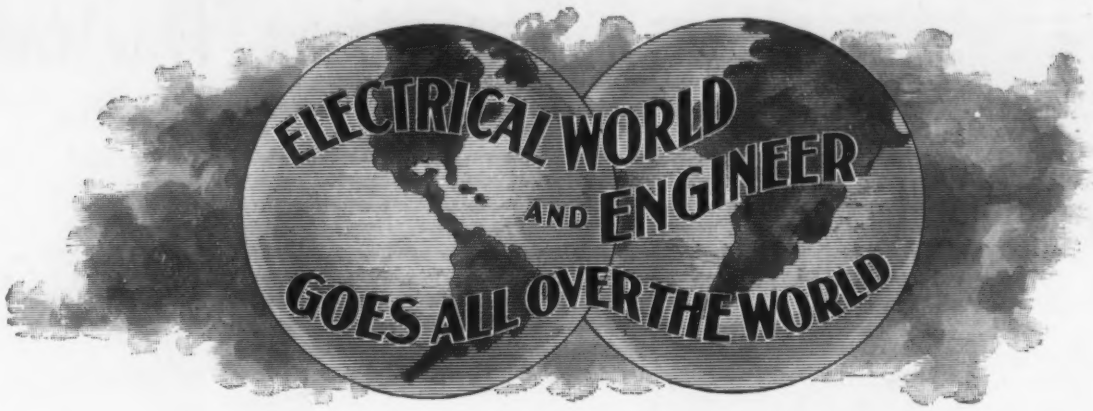

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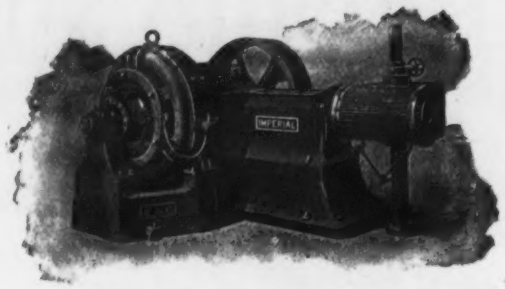

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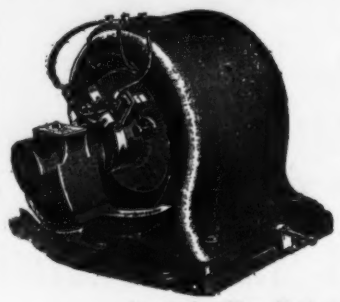

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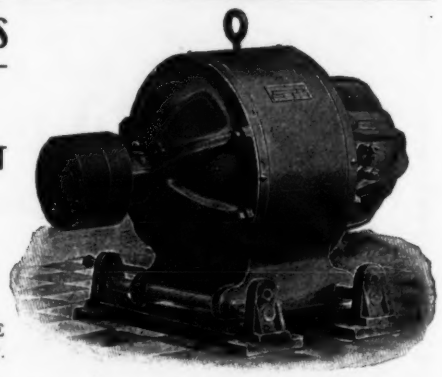

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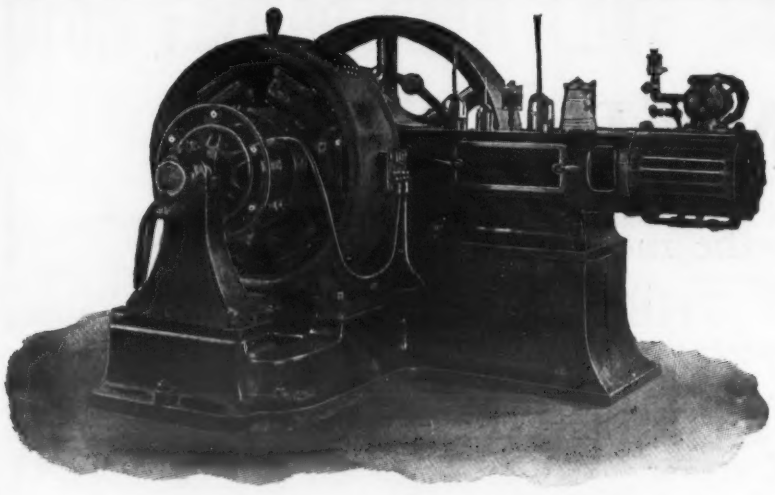

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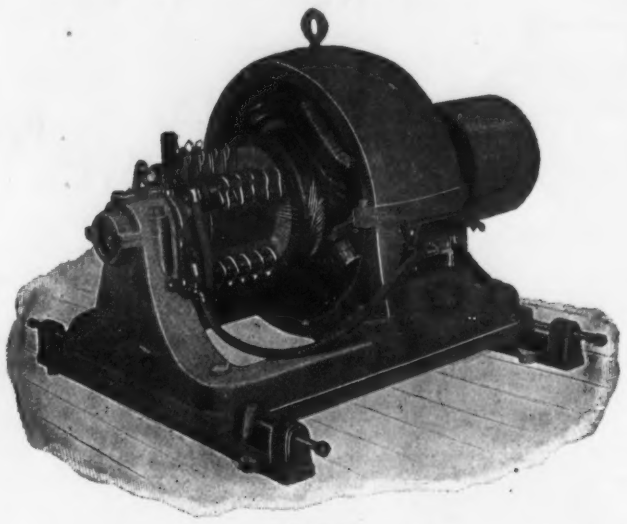

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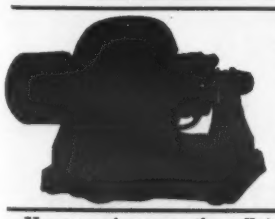

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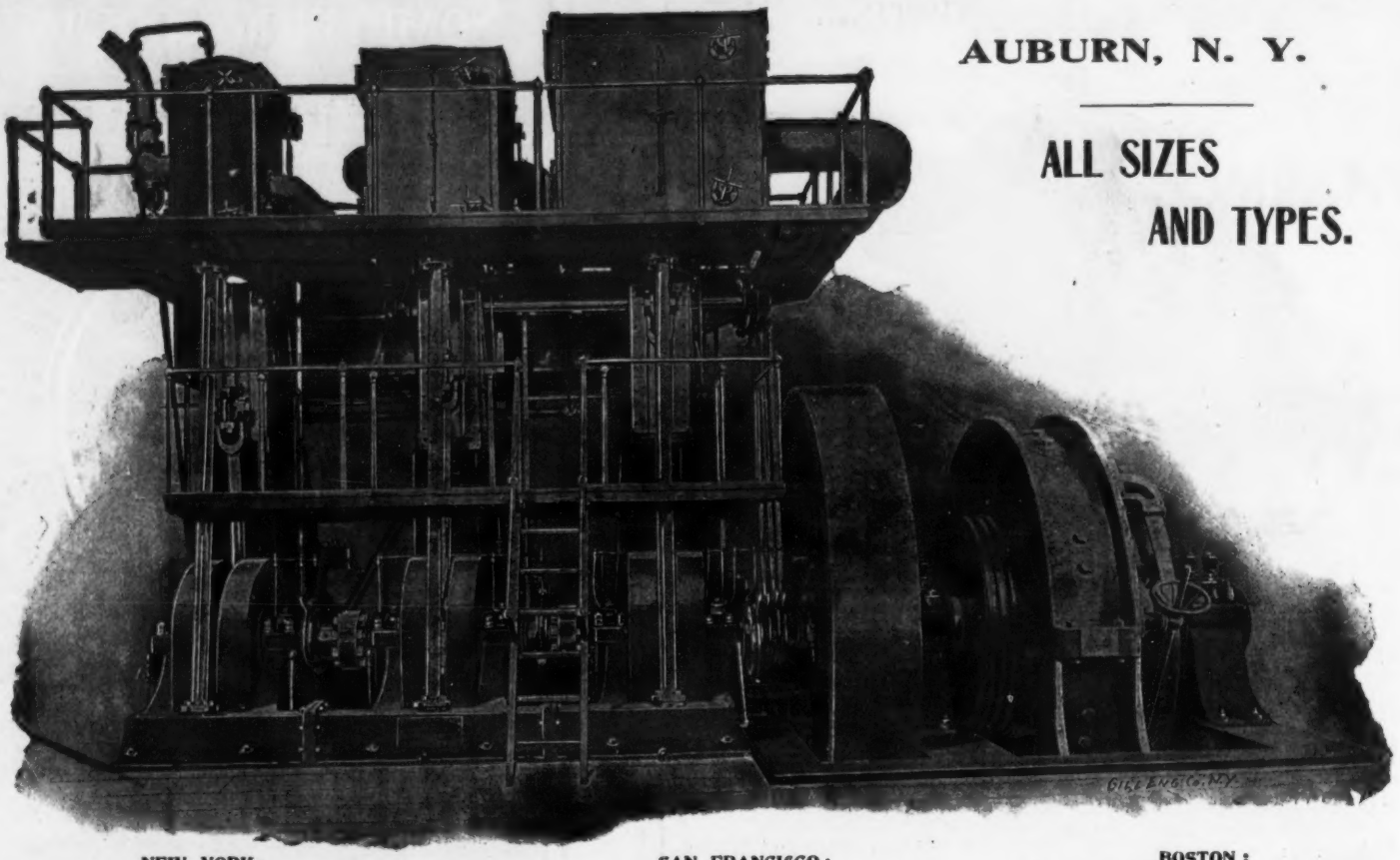

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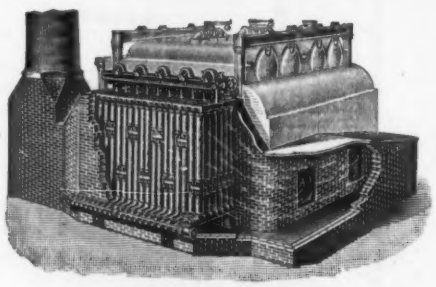

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APPENDIX.—I. Alternate Current Calculations: the Symbolic Method. II. Schedule of Polyphase Patents. Index.

LIST OF PLATES.

I. Two-Phase Generator at Chevres. II. Three-Phase Inductor Alternator. III. Two-Phase Motor of Six Horse-Power. IV. Three-Phase Motor of One Hundred Horse-Power. V. Three-Phase Motor of Twenty Horse-Power. VI. Core-Disks of Three-Phase Motor. VII. Two-Phase Motor of One Thousand Horse-Power. VIII. Locomotive of the Jungfrau Railway.

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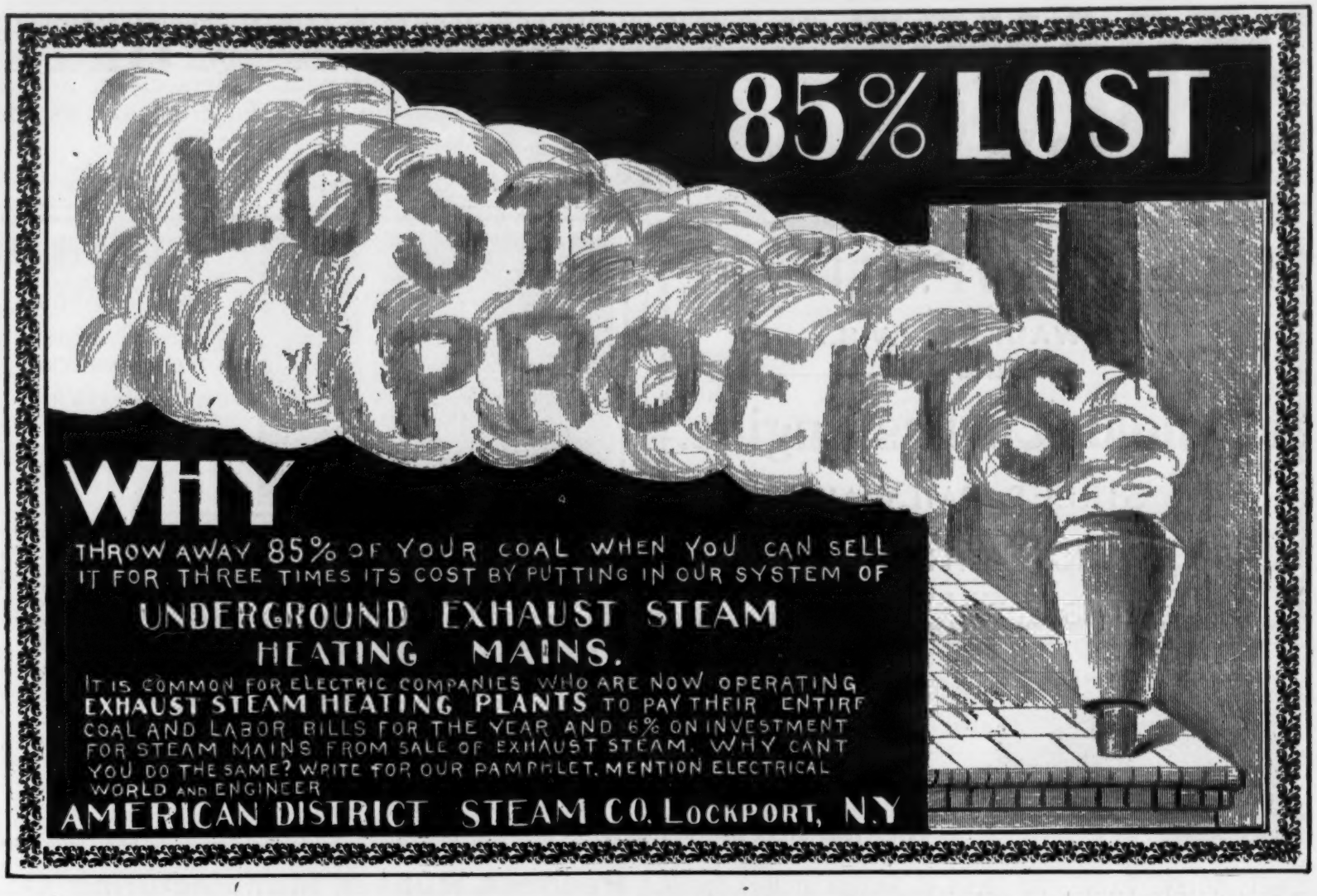
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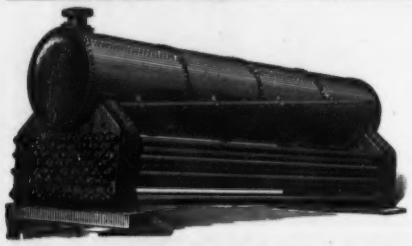

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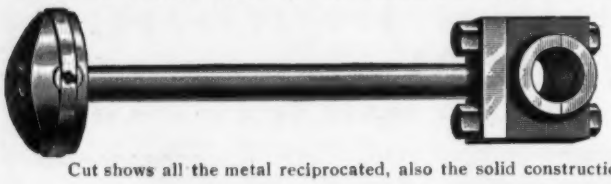

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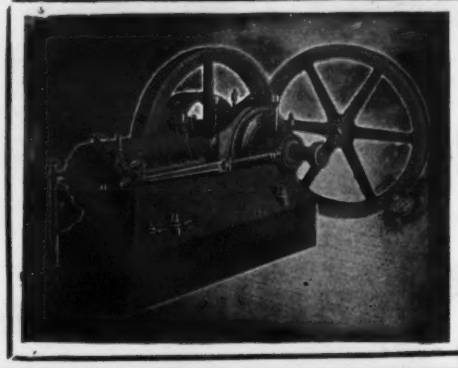

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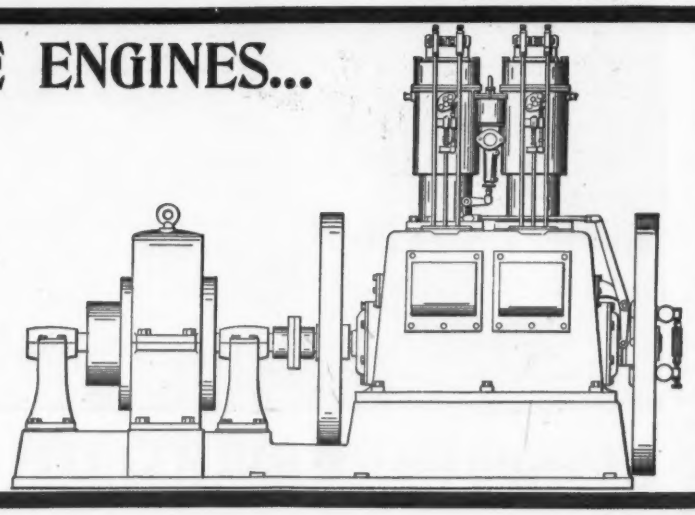

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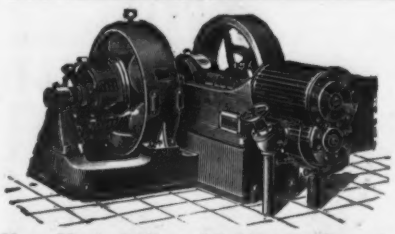

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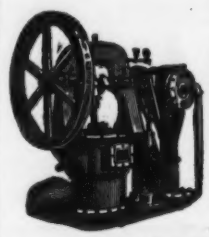

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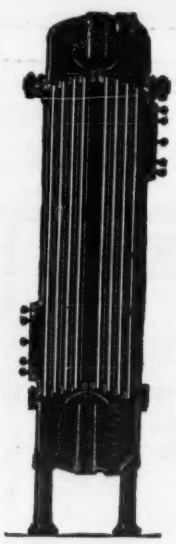

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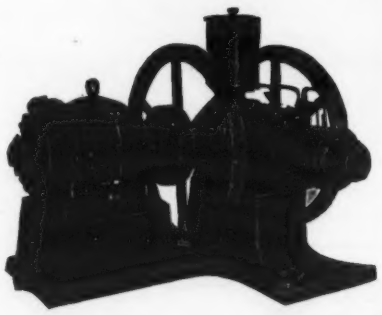

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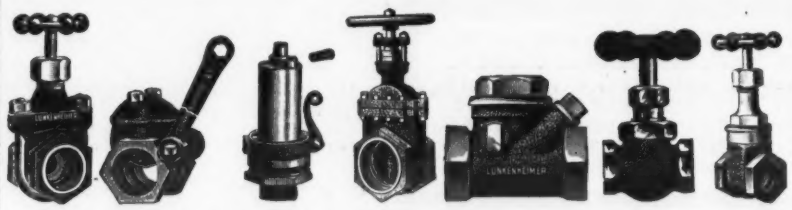

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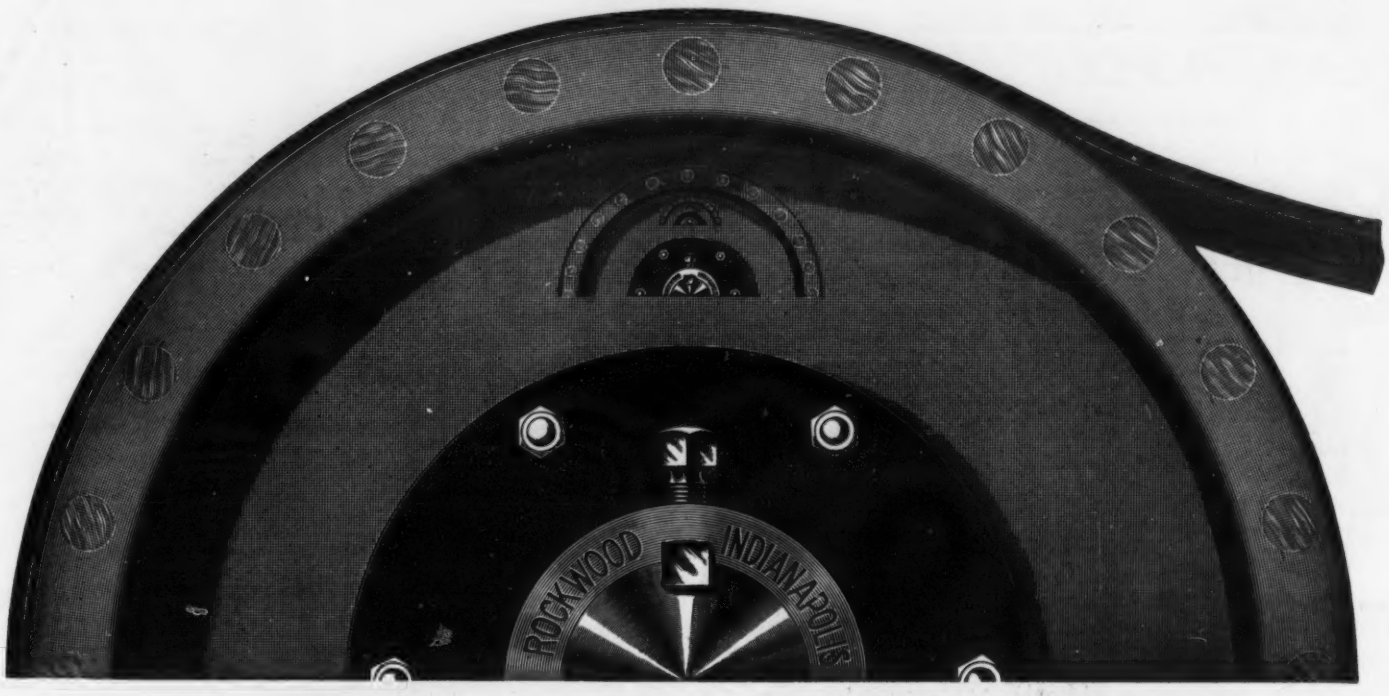

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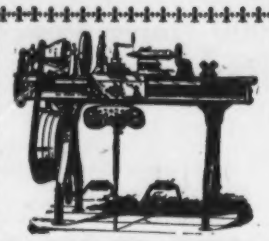

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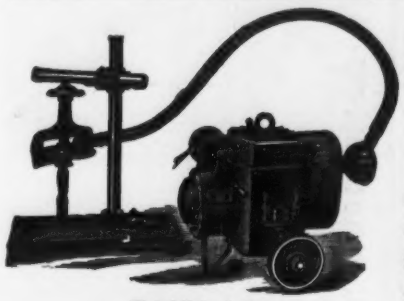

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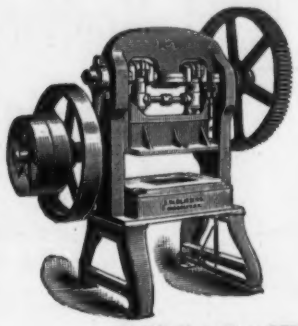

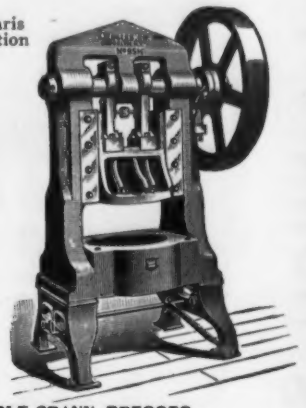

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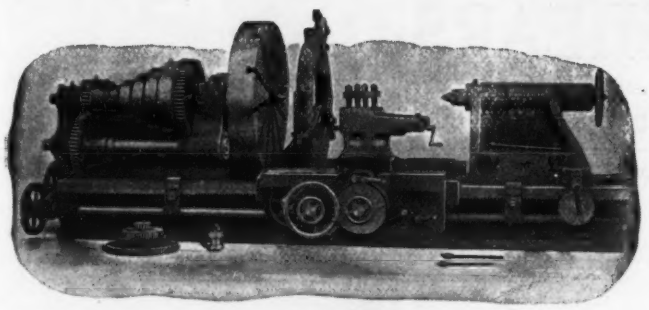

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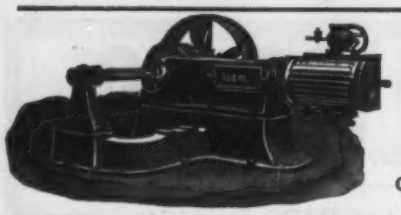

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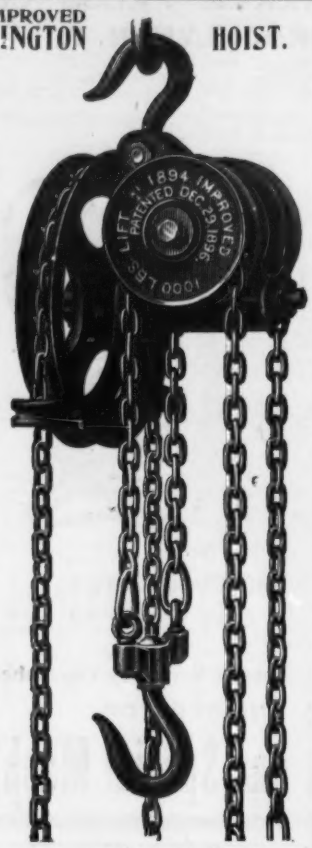

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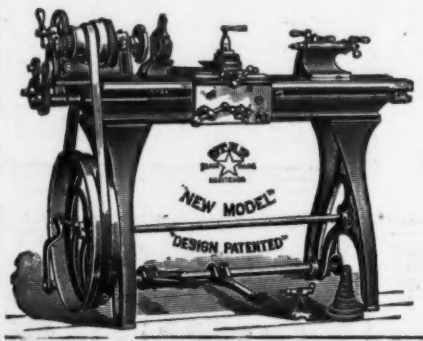

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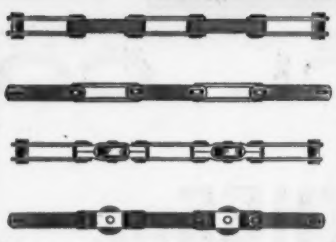

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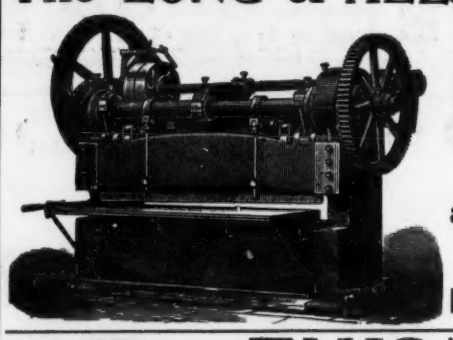

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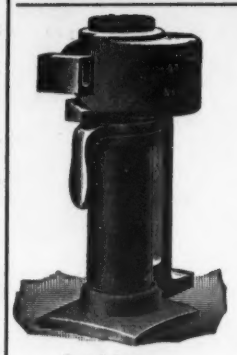

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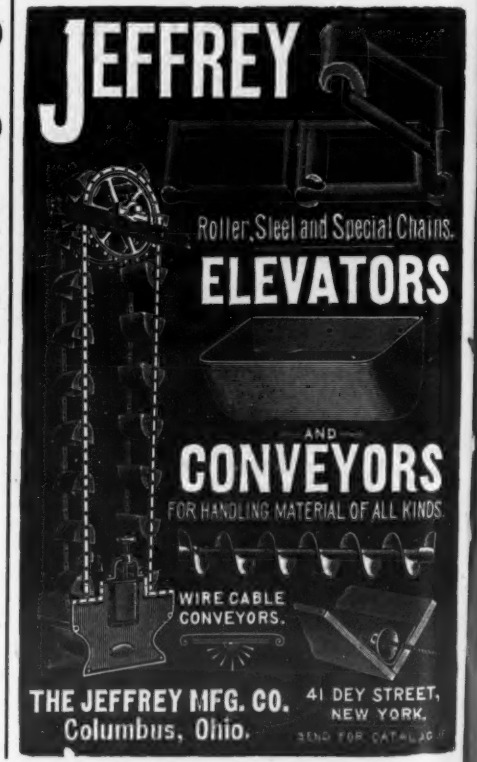

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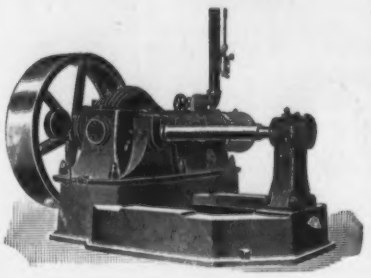

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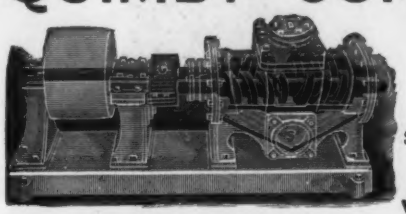

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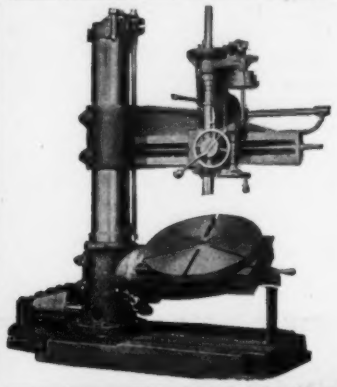

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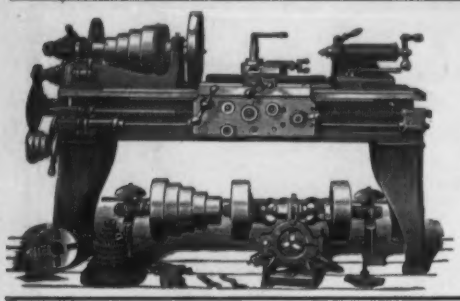

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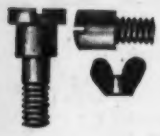

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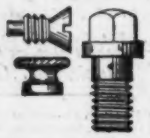

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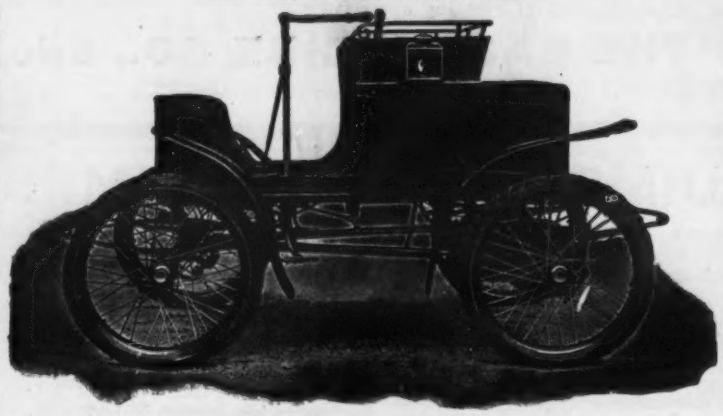

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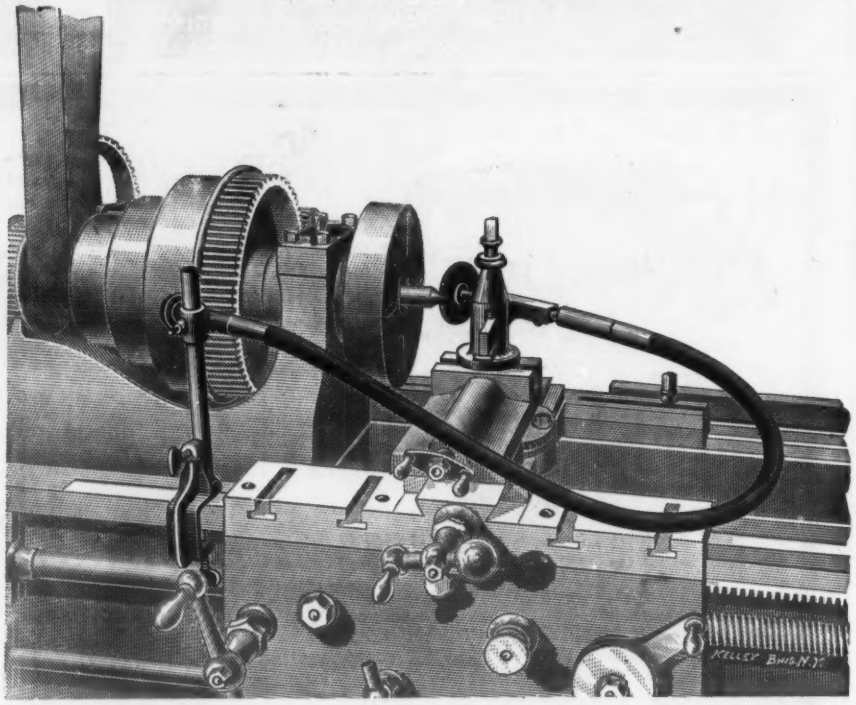

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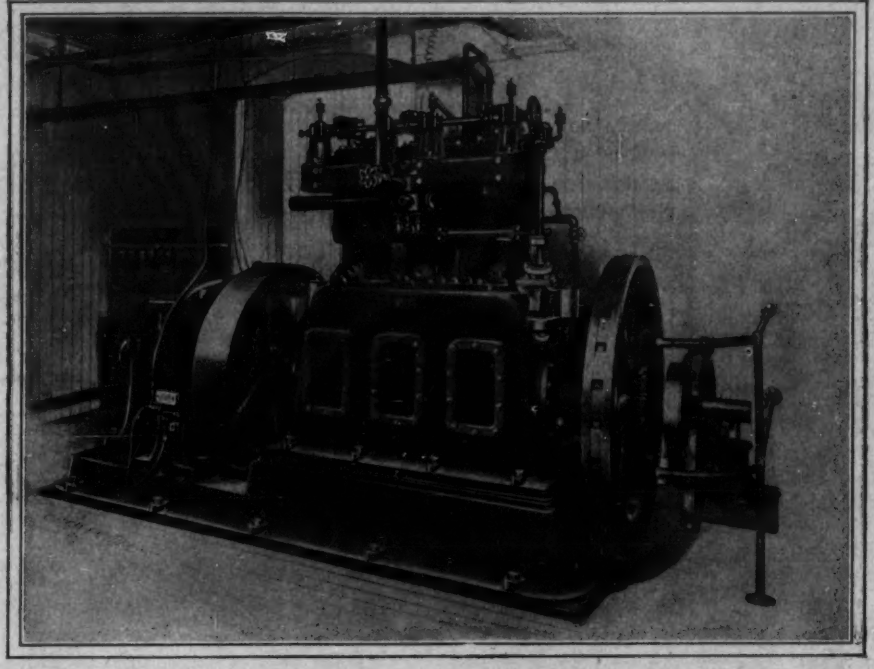

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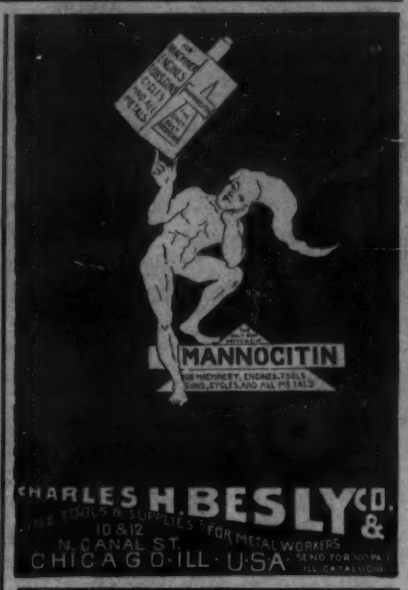

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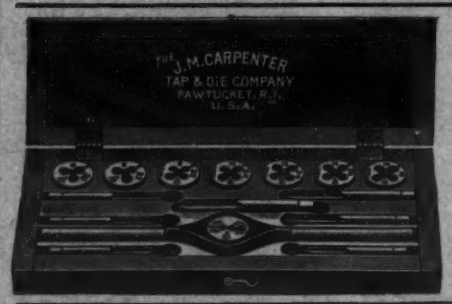

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